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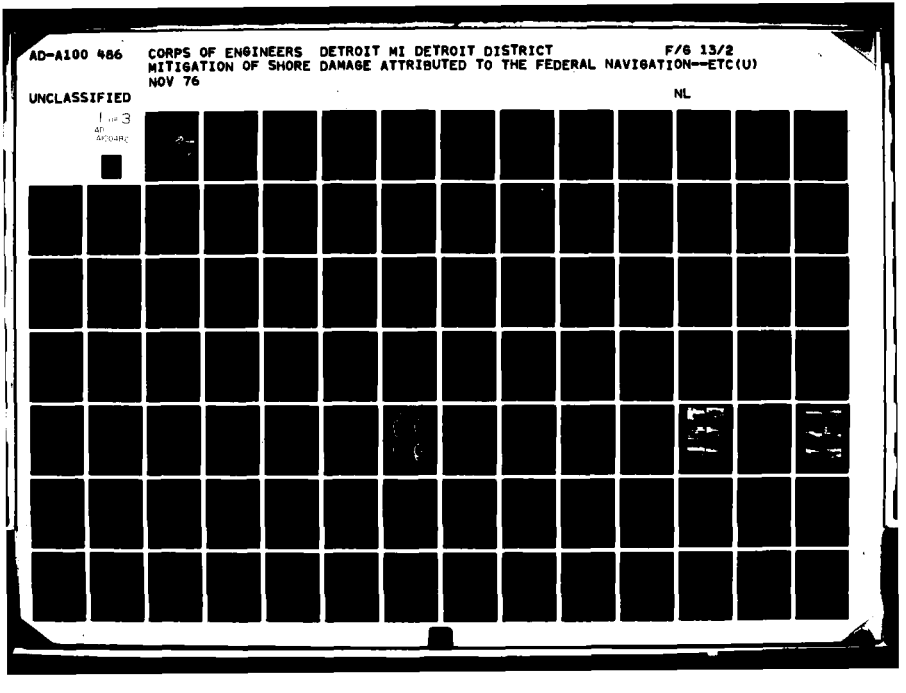

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LEVEL II

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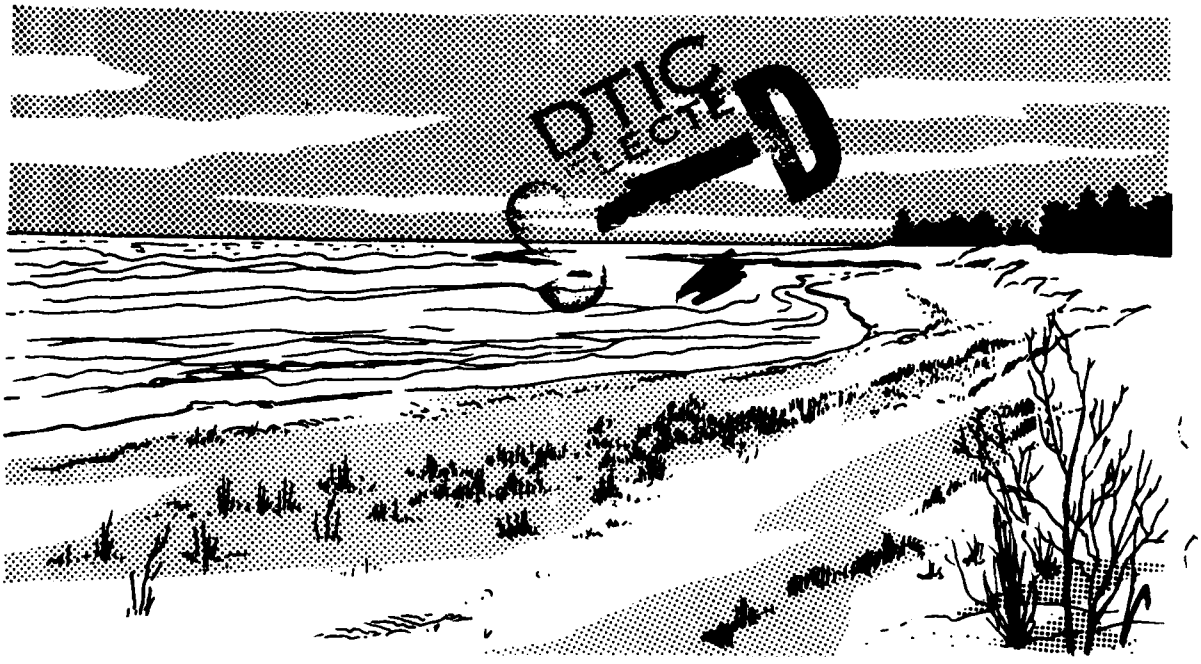
ENVIRONMENTAL STATEMENT

MITIGATION OF SHORE DAMAGE ATTRIBUTED TO THE FEDERAL NAVIGATION STRUCTURES AT



HAMMOND BAY HARBOR MICHIGAN

U. S. ARMY ENGINEER DISTRICT
DETROIT, MICHIGAN

NOVEMBER 1976

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Beach Erosion	Environmental areas	Shore-Type
Breakwater	Geomorphology	
Erosion	Hammond Bay	
Ecology	Harbors-of-refuge	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Studies have determined that the erosion problem along a well-defined zone in the vicinity of Hammond Bay Harbor, Presque Isle County, Michigan is attributed to the federal navigation structures. The Corps proposes to mitigate the shore erosion damage by a structural approach through construction of an artificially-filled groin at the site of severe harbor-induced damage. Several alternatives to the proposed action were considered. These studies involved the public at Hammond Bay, the local, state, and federal agencies in the consideration of the project.

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SUMMARY

MITIGATION OF SHORE DAMAGE
ATTRIBUTED TO THE FEDERAL NAVIGATION STRUCTURES
AT
HAMMOND BAY HARBOR, MICHIGAN

( ) DRAFT (X) FINAL ENVIRONMENTAL REPORT

RESPONSIBLE OFFICE: U.S. ARMY ENGINEER DISTRICT, DETROIT, Corps of Engineers, P.O. Box 1027 Detroit, Michigan 48231, Telephone (313) 226-6752

NAME OF ACTION: (X) ADMINISTRATIVE ( ) LEGISLATIVE

1.1 DESCRIPTION OF ACTION: The Corps of Engineers proposes to mitigate shore erosion damage in the vicinity of Hammond Bay Harbor, Presque Isle County, Michigan, that is attributable to the Federal navigation structures at the harbor. Studies have determined that the erosion problem along a well-defined zone of adverse influence is wholly attributable to the harbor structure. The plan considered most practical for this purpose is a structural approach entailing the construction of an artificially-filled groin at the site of severe harbor-induced damage. There are three basic elements to this mitigation plan: (1) groin construction, (2) initial beach fill north of the groin, and (3) the shoreline modification resulting from the first two construction aspects.

1.2 Construction of a 150-foot groin would halt littoral drift travel toward the harbor structures, which currently results in shoreline erosion. An unfilled groin would eventually stop erosion after sufficient material (eroded from

R4/14/77

the already-damaged shoreline) had filled the north side of the groin. To avoid such continued erosion and damage, the groin will be artificially filled with 3,000 cubic yards of imported material. The total time required for groin construction and beach fill actions is expected to be less than one month.

2.1 ENVIRONMENTAL IMPACTS: Analysis of the proposed plan has resulted in the identification of 49 potential impacts, most of which are negative. All such negative effects are associated with the short-term action aspects of constructing an artificially-filled rock groin. The majority of positive impacts will result in long-term benefits associated with shoreline modification. Essentially, the short-term negative impacts associated with construction are necessary in order to bring about the long-term benefits of shoreline stability and mitigation of harbor-induced erosion.

2.2 The proposed rock groin would be about 150 feet long, 20 feet wide at its base, and would be of rubble-mound construction using imported rock as armoring. Significant impacts associated with its construction include the destruction of 3,000 square feet of benthic habitat and associated organisms, the destruction of 1,200 square feet of terrestrial vegetation at the site of an access road required for the delivery of groin materials, and the noise and traffic problems associated with truck delivery of construction materials.

2.3 Artificially filling the groin would provide a beach 60 feet wide and 450 feet long immediately north of the rock groin. Significant impacts include the localized accretion

and elimination of erosion at the site, the ultimate destruction of about 37,000 square feet of benthic habitat and associated organisms, the destruction of terrestrial vegetation associated with access roads, and the noise and shoreline serenity impacts associated with continual construction for one month.

2.4 A third action aspect, modification of the shoreline, is really a result of the first two. This aspect considers the long-term implications of groin construction and beach fill as they alter the current nearshore processes. Expected impacts include a significantly more stable shoreline, enhanced accretion, and sharply-reduced erosion. Terrestrial vegetation that is now threatened due to erosion will benefit. Local property values will not suffer the decline expected if current erosion trends were allowed to continue. A recreationally useful beach will be created.

3.1 ADVERSE ENVIRONMENTAL EFFECTS: Identified negative impacts would result from the construction aspects of the proposed plan. The rock groin and beach construction actions would destroy a combined total of 40,000 square feet of benthic habitat and associated organisms. Delivery of construction materials would result in the destruction of about 1,200 square feet of terrestrial vegetation. Plant and animal species of threatened or endangered status would not be affected by the proposed project.

3.2 The use of trucks and other heavy equipment during construction would result in impacts due to noise and exhaust emissions. Approximately 415 truck-loads of materials would be required for the project, in addition to the light equipment

used for rock placement and beach construction. Air quality, birds, noise, and the health and safety of shoreline residents would be negatively impacted. In addition, the construction activity would result in negative impacts to shoreline serenity, aesthetics, and recreation for the duration of construction. It is significant to note that all expected social adverse impacts would not continue after necessary construction activity has ceased.

4.1 ALTERNATIVES TO THE PROPOSED ACTION: Alternative solutions considered were:

(1) A "No-Action" scheme; this alternative would not satisfy the mandate of Section 111 of P.L. 90-483 since it has been established that a portion of the shore damage is attributable to the Federal navigation project. Although this alternative would involve no initial Federal expenditure, continued shoreline erosion and associated property losses would eventually result in necessary Federal reparations.

(2) Riparian Zone Management; the Corps of Engineers has no authority to establish zoning regulations. However, public programs can be utilized to educate the local populace about prevailing erosion risks and methods of minimizing losses.

(3) Modification of Navigation Structures; this alternative would involve the reshaping or removal of a portion of the harbor

structures, both of which would entail considerable expenditure.

(4) Complete Removal of Navigation Structures; this alternative would result in a restoration of the natural balance and a cessation of erosion north of the harbor. Submerged rocky habitat would be removed and the spit would also disappear. The nearest harbors-of-refuge, however, would then be at Rogers City and Cheboygan, increasing the navigation hazards to small craft.

(5) Protective Beaches; this alternative can stop erosion and provide additional beach areas, but the construction involved would cause periodic localized turbidity and damage to benthic biota. Costs exceed expected benefits from this alternative.

(6) Feeder Beach; this method depends on wave action to distribute the deposited fill. There is less construction nuisance than with protective beaches, but a decrease in relative effectiveness is expected.

(7) Nearshore Nourishment Sites; this alternative is similar to the feeder beach concept except that the feeder material is placed in nearshore waters. This is a

relatively inexpensive method, but costs still exceed benefits.

(8) Continuous Armor Protection; this alternative provides a high degree of protection. However, continuous shoreline armor is extremely expensive and reduces beach attractiveness, recreation potential, tourism, and shore landing safety.

(9) Groins at Shoreline Damage Area; a single groin placed near the first evidence of erosion north of the harbor would be effective in reducing erosion, land loss, and bluff sloughing. Rocky habitat would be increased and pockets of littoral material would accrue. The refuge harbor would be maintained and Federal shore damage liability would be reduced.

(10) Artificially-Filled Groins at Shoreline Damage Area; this alternative is more effective than unfilled groins since it replaces the eroded sandy beach, eliminates erosion of the damaged shoreline, and limits the construction nuisance to a one-time occurrence. Alternative 10 constitutes the proposed plan.

(11) Offshore Breakwaters; an extended offshore breakwater would provide protection in excess of the Federal liability, and the costs far exceed the benefits expected.

(12) Offshore Breakwaters and Beach Nourishment; this method would establish a stable bottom profile and protective beach sooner than would an offshore breakwater by itself. However, extreme Federal costs would result in no net benefits to national economic development.

5.1 COMMENTS RECEIVED:

Advisory Council on Historic Preservation

U.S. Department of Agriculture
-Soil Conservation Service

U.S. Department of Commerce
-National Oceanic & Atmospheric Administration

U.S. Department of Health, Education & Welfare

U.S. Department of the Interior

U.S. Department of Transportation
-Federal Highway Administration
-U.S. Coast Guard

U.S. Environmental Protection Agency

Michigan Department of Natural Resources

Michigan Department of State Highways and Transportation

6.1 DRAFT STATEMENT TO CEQ ON 19 JULY 76

6.2 FINAL STATEMENT TO EPA ON _____

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MITIGATION OF SHORE DAMAGE ATTRIBUTED TO THE FEDERAL NAVIGATION STRUCTURES AT HAMMOND BAY HARBOR, MICHIGAN

1. PROJECT DESCRIPTION

1.01 Section 111 of the River and Harbor Act of 1968 (P.L. 90-483) authorizes the Secretary of the Army, acting through the Chief of Engineers, to investigate, study, and construct projects for the prevention or mitigation of shore damages attributable to Federal navigation works. The cost of installing, operating, and maintaining such projects shall be borne entirely by the United States. However, no such projects can be constructed without specific authorization by Congress if the estimated first cost exceeds $1,000,000.

1.02 The Section 111 authority provides only for mitigation of erosion in excess of the natural rate. Factors which may not be mitigated under this authority are the effects of wind and wave action, violent storms, high water levels and normal erosion processes, as well as possible adverse effects from beneficially-intended shore protective structures, including man-made changes or adjustments in the shorefront configuration. Investigations of these factors revealed that the Federal navigation structures at Hammond Bay were responsible for erosion damage in a reach about 1,800 feet (549 m) long from Pond Point to a point 700 feet (213 m) north of the harbor. The southerly 450 feet (137 m) of this reach suffers the most severe and obvious effect of the erosion. Essentially, all of the erosion in this localized area is attributable to the Federal navigation structures at Hammond Bay Harbor. Through groin construction

and beach filling, the proposed project is designed to minimize erosion and related damage due to the harbor's influence.

1.03 Hammond Bay Harbor is located on the west shore of Lake Huron approximately 310 miles (449 km) northeast of Chicago, 21 miles (34 km) northwest of Rogers City, and 20 miles (32 km) southeast of Cheboygan (see Figure 1). The navigation structure acts as a harbor of refuge for small craft seeking safety from sudden storms. The harbor also offers limited recreational benefits as seasonal sportsmen fish from the inner pier.

1.04 The coastal zone in the vicinity of Hammond Bay Harbor is characterized by accretion and erosion. Studies have shown that the Federally-constructed navigation structures have modified erosion and accretion patterns along a 4,000-foot (1,200-m) stretch of shoreline between Highway Point and Pond Point (see Plate 1). Erosion problems located within the 2,500 foot reach (763) north of the west breakwater are attributable to the Federal navigation project harbor structures at Hammond Bay Harbor. In recent years, high lake levels have greatly expanded the extent of this problem. Aerial photographs taken of the harbor and adjacent coastline area from 1938 through 1973 were analyzed. Annual erosion and accretion computations were made from which averages were determined. The results are summarized in the U.S. ARMY CORPS OF ENGINEERS SECTION 111 DETAILED PROJECT REPORT (DPR) ON SHORE DAMAGE AT HAMMOND BAY HARBOR, MICHIGAN.

1.05 Before harbor construction (in the early 1960's) the natural condition of the small embayment which now contains Hammond Bay Harbor was one of relative stability. Material would slowly erode from the points and flow into the bay to

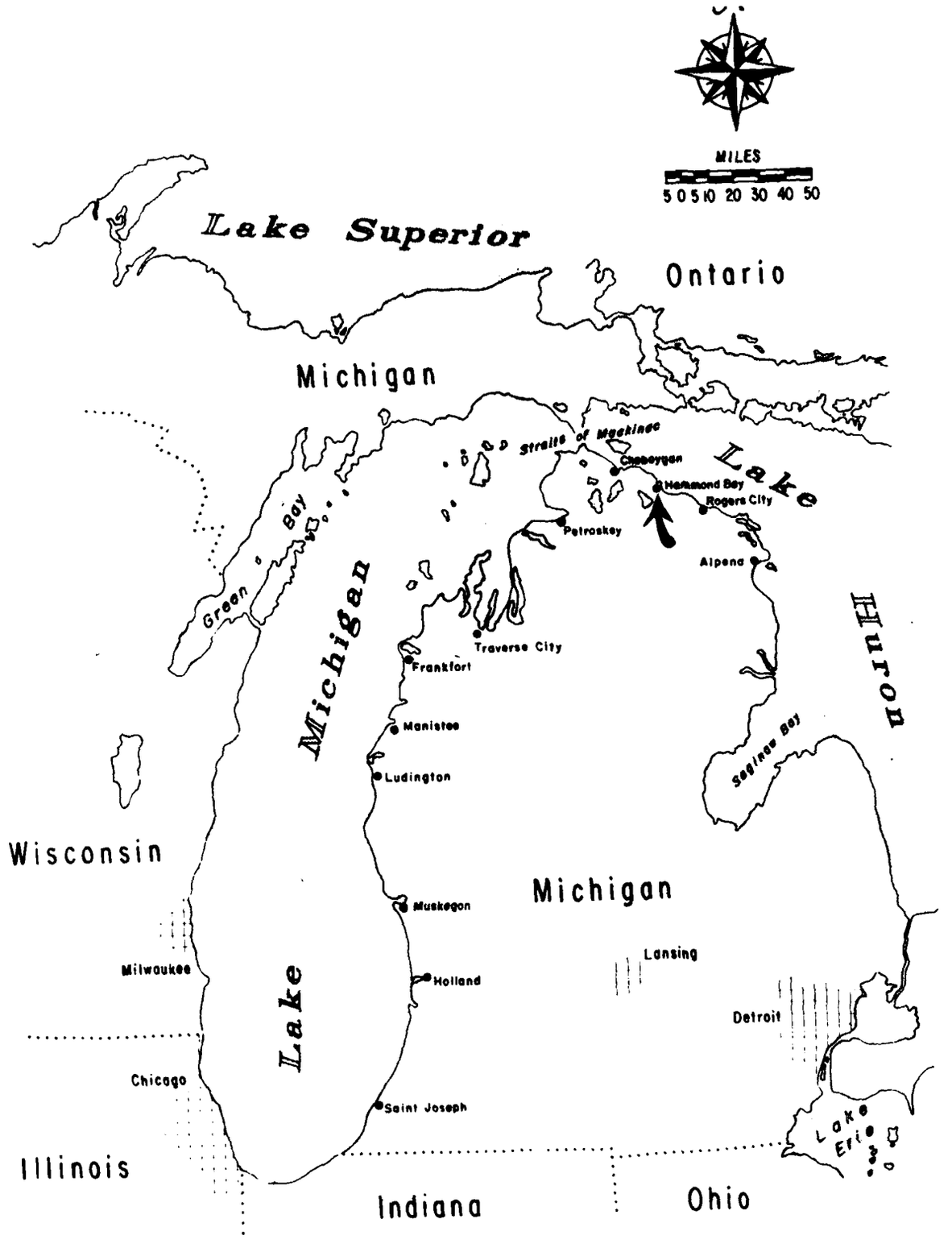


FIGURE 1. General Location Map

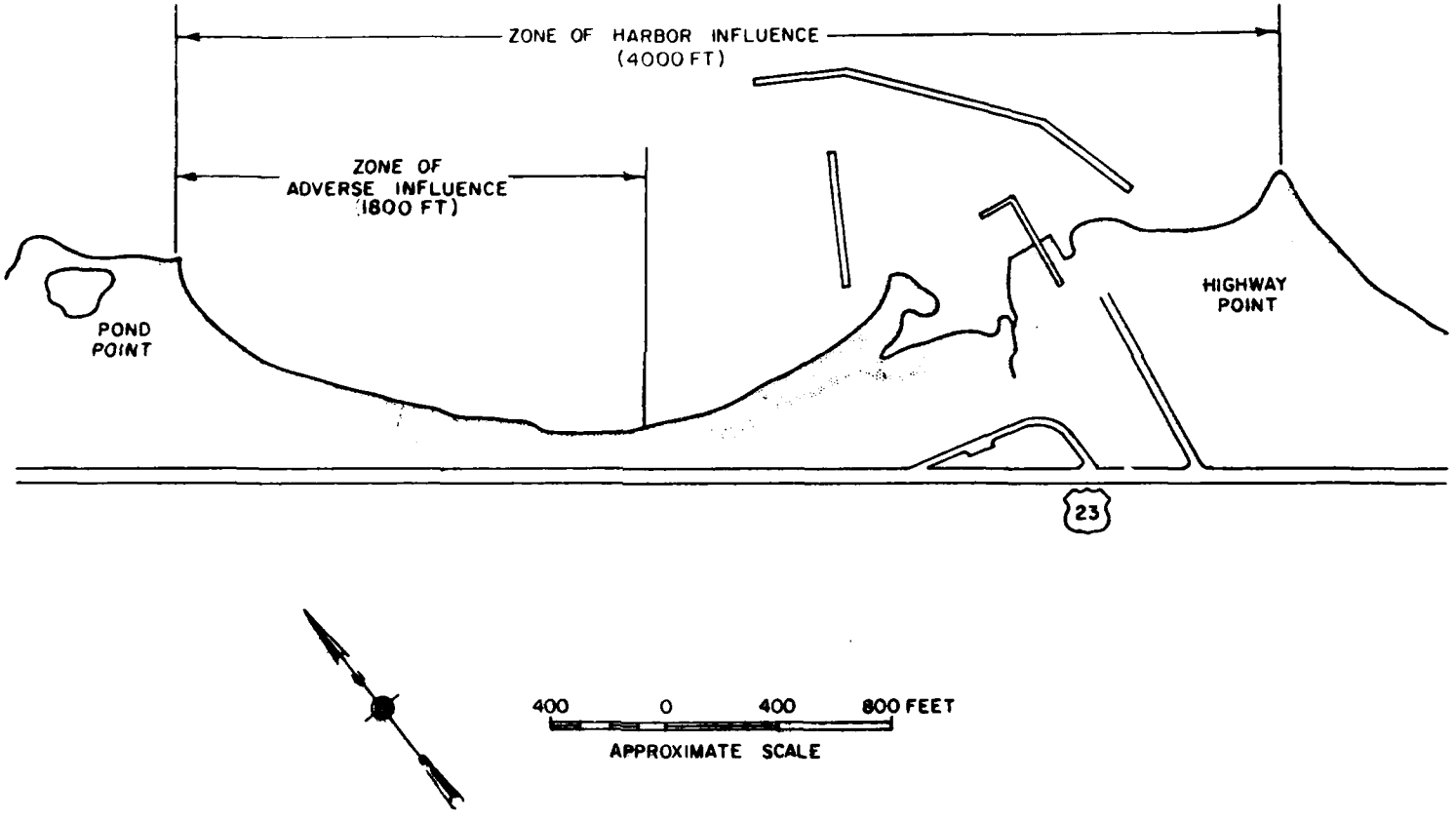


PLATE 1. View of Hammond Bay Area Showing Zones of Harbor Influence

form a pocket beach. The rates of erosion and accretion were both quite slow. The changes since 1963 have been so rapid that the navigation structures can only be responsible for the damage observed. Were it not for the presence of privately-constructed shore protection structures about 1,150 feet (350 m) north of the west breakwater, erosion damage would probably have been much worse. There has been no identifiable harbor-induced damage or benefit to the shoreline south of Highway Point.

1.06 The manner in which the harbor causes erosion of the shoreline is by altering the natural wave exposure of the beach. Most of the southerly component of wave energy is prevented from reaching the beach. Hence, material which moves into the shadow of the harbor during periods of northerly wave energy is prevented from moving back to the north when the wave climate changes. Since the harbor lies in a small bay bounded on either end by natural littoral barriers, and since no other significant sediment source has been identified, the harbor structures are, for all practical purposes, wholly responsible for erosion occurring within the 2,500-foot (763-m) reach north of the harbor.

1.07 Since the harbor is trapping littoral material, the adjacent shoreline has been deprived of significant quantities of sand as a direct result of the harbor's presence. This deprivation is the major cause of erosion near the harbor. Since correction of most of the harbor-caused erosion is economically feasible, Section 111 of the River and Harbor Act of 1968, P.L. 90-483, authorizes formulation of a mitigation plan.

Improvement Plan and Mode of Implementation

1.08 A plan has been formulated which provides the best use of water and related land resources to meet the identified needs of the Hammond Bay Harbor area, consistent with the scope of investigations permitted under the Section 111 authority. The proposed plan for mitigating erosion damage due to the Hammond Bay navigation structures is intended for implementation along the reach of shoreline suffering severe harbor-induced damage. That reach extends southerly a distance of about 450 feet (137 m) from the existing shore protection structures north of the harbor (see Figure 2). There are three basic elements to this mitigation plan: (1) groin construction; (2) initial beach fill north of the groin; and (3) the shoreline modification resulting from the first two construction elements.

1.09 Groin Construction. The proposed mitigation plan would place a 150-foot (46-m) long rock groin approximately 700 feet (214 m) north of the harbor structures. The groin would extend lakeward in a direction perpendicular to the bluff line to a maximum water depth of about 3 feet (0.9 m) below Lower Water Datum. It is recommended that the groin be of rubble-mound construction using imported rock as armoring.

1.10 The site selected for groin construction lies at the approximate position of the start of serious erosion--the transition point between accretion near the harbor and erosion to the north. Construction of a groin would halt littoral drift travel toward the harbor structures and alleviate the demand for material from the eroding shore.

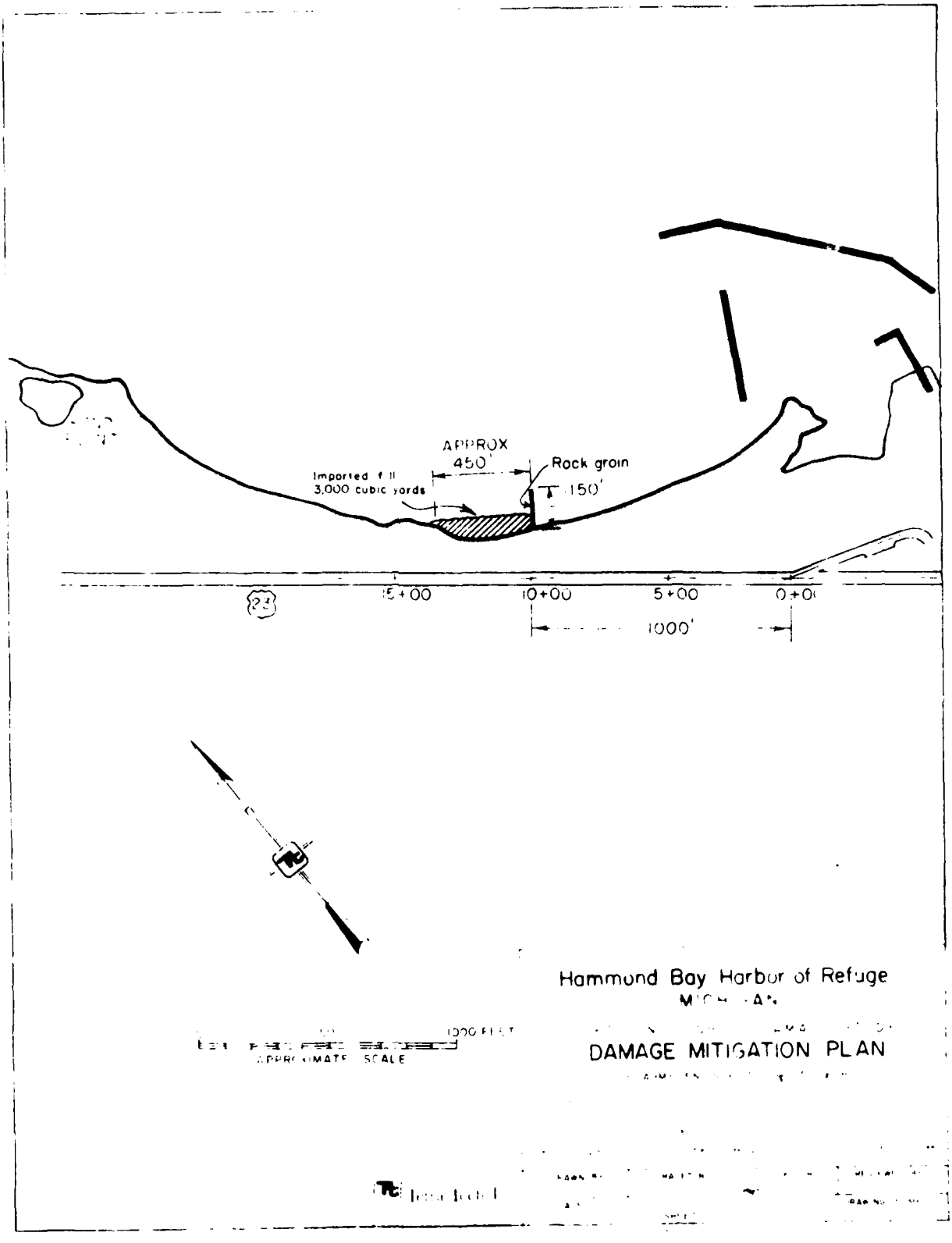


FIGURE 2. Proposed Mitigation Plan

1.11 Initial Beach Fill. To the north of the groin and extending to the existing shore protection structures, about 3,000 cubic yards (2,295 cu m) of imported beach fill would be placed one time only in the erosion pocket (see Figure 2). An unfilled groin would eventually stop erosion after sufficient material (eroded from the already-suffering shoreline to the north) had piled against the north side of the groin. This would require the additional erosion of about 9,000 square feet (840 sq m) of beach-front land, resulting in an average retreat of 5 feet (1.5 m) for the 1,800 feet (550 m) of shoreline contributing the material. To avoid such continued erosion and damage, the material required to fill the groin initially [3,000 cu yds (230 cu m)] would be supplied from a quarry within the region. The need for annual replenishment of such beach fill is not anticipated. The total time required for groin construction and beach fill activities is expected to be less than one month.

1.12 Shoreline Modification. Construction of a groin and subsequent filling of the adjacent beach will have an overall effect of modifying the existing shoreline, water circulation patterns, littoral drift, and various other physical factors affecting shoreline erosion and accretion. The groin will block further passage of littoral material from the northerly shoreline to the accretion spit adjacent to the harbor. The beach fill will form a more stable beach configuration and eliminate the demand for additional material from the north. This combination of actions would result in protection to that part of the shoreline suffering harbor-induced erosion. While a degree of uncertainty accompanies any such erosion-mitigation project, it is believed that substantial benefits will result.

Remedial and Mitigative Actions

1.13 The purpose of identifying remedial and mitigative actions, and their incorporation into the proposed project, is to reduce or eliminate the magnitude of adverse impacts and to maximize benefits resulting from the project. Several remedial and mitigative actions have been identified for the Section 111 Project at Hammond Bay Harbor and include the following:

- Groin construction in nearshore waters usually results in the introduction of a new type of habitat to the area. This new habitat is quickly utilized by aquatic organisms as substrate suitable for attachment, hiding, feeding, and spawning activities. The texture or configuration of the groin surface does affect its utilization by organisms; a smooth surface is not as suitable as is a rough textured surface having many niches. It is therefore recommended that rough-hewn rocks, if available at a competitive price, be used for groin construction.

- In order to minimize beach construction activities, beach fill should be placed in a few locations and allowed to distribute itself along the shoreline by wave action. The configuration of the beach fill is not critical because littoral processes will eventually establish the natural slope and configuration of the unpolluted fill as the

material is sorted. However, the fill would be placed where it would be influenced by shore processes for distribution to a suitable configuration. The stability of the beach will be monitored to detect any future demands.

- In order to minimize the overall impact of placing 3,000 cubic yards (230 cu m) of material on the beach, the required fill should match the characteristics of native material as closely as possible. The fill material should, therefore, be a mixture of sand and gravel, evenly graded from fine sand to 0.5-inch (1.3 cm) gravel. The median diameter should not exceed 0.25 inch (0.63 cm). Fill should not be borrowed from the beach, but should be imported from an inland quarry where clean, graded fill can be found.

- Since construction of the groin and beach fill will require about one month of shoreline work, and since such construction will involve nearshore, rocky bottomlands of Lake Huron, a potential adverse impact to fish species will result. Certain fish utilize the nearshore area as spawning and foraging grounds during certain times of the year. In order to minimize the potential

effect of the project, it is proposed that construction take place within the time frame recommended by Michigan's Department of Natural Resources, Fisheries Division, as being best for avoiding impacts to fish and fishery activities: after late June and before mid-September.

- Presently, two access routes from U.S. Route 23 to the site of proposed construction are anticipated as being needed: one to allow trucks to deliver groin and beach fill materials to the southern part of the site, and another access for delivery to the northernmost beach fill area. An old, dirt driveway leading to an abandoned house (which has since been claimed by the Lake) currently connects the beach with Route 23 near the mid-point part of the erosion pocket. It is proposed that this driveway serve as one of the anticipated access routes, thereby reducing the amount of vegetation destroyed during construction.

- Upon completion of construction activities, crews usually initiate a process of "clean-up", whereby the original environment is returned, as nearly as possible, to its original state. It has been noted that compaction of the soil between the shore and Route 23 tends to resist existing plant groups as revegetation occurs (as evidenced by the

aforementioned existing driveway). In order to facilitate such regrowth and, thus, minimize the impacts of construction on terrestrial plants, it will be required that the ground suffering compaction due to equipment traffic be tilled and replanted as a part of clean-up activities.

1.14 The remedial and mitigative actions identified above represent important additions to the project that will minimize adverse effects while providing protection to the shore erosion area effected by the navigation structures. The erosion in the embayment will be checked and a more stable beach will result. Such a plan is within the limits of the Section 111 authority.

Economic Considerations

1.15 Economic consideration was given to the cost for implementing the plan of improvement, and a comparison was made with the anticipated costs of derived benefits. Exact dollar figures calculated for the following economic-consideration's data can be found in the Appendix A, economic data extracted from THE U.S. ARMY CORPS OF ENGINEERS SECTION 111 DETAILED PROJECT REPORT ON SHORE DAMAGE AT HAMMOND BAY HARBOR, MICHIGAN.

1.16 Justification for the proposed action was evaluated in accordance with expected benefits to be derived as a result of damage prevention, improvement of property values, and recreational enhancement. Lakefront land values and existing

roadways and houses were given prime consideration in this evaluation. Present worth costs were amortized at 6-1/8% interest over a projected project life of 50 years. Regarding recreation, the anticipated creation of new public beaches was not expected to yield a significant benefit beyond that of preventing loss of land. This is based on the fact that existing beaches in the area are not presently being fully utilized and assumes that only a slight increase in population is projected over the next 20 years.

1.17 The estimated cost of the recommended plan and the expected benefit (in dollars) to be realized if the proposed action is implemented can be found in Appendix A's ECONOMIC DATA SHEET. Based on these, a benefit/cost (B/C) ratio of approximately 3.5 is derived, thereby providing economic justification for the project. The B/C ratio can be defined as the total dollar value of expected benefits divided by the total projected cost of the proposed action leading to these benefits.

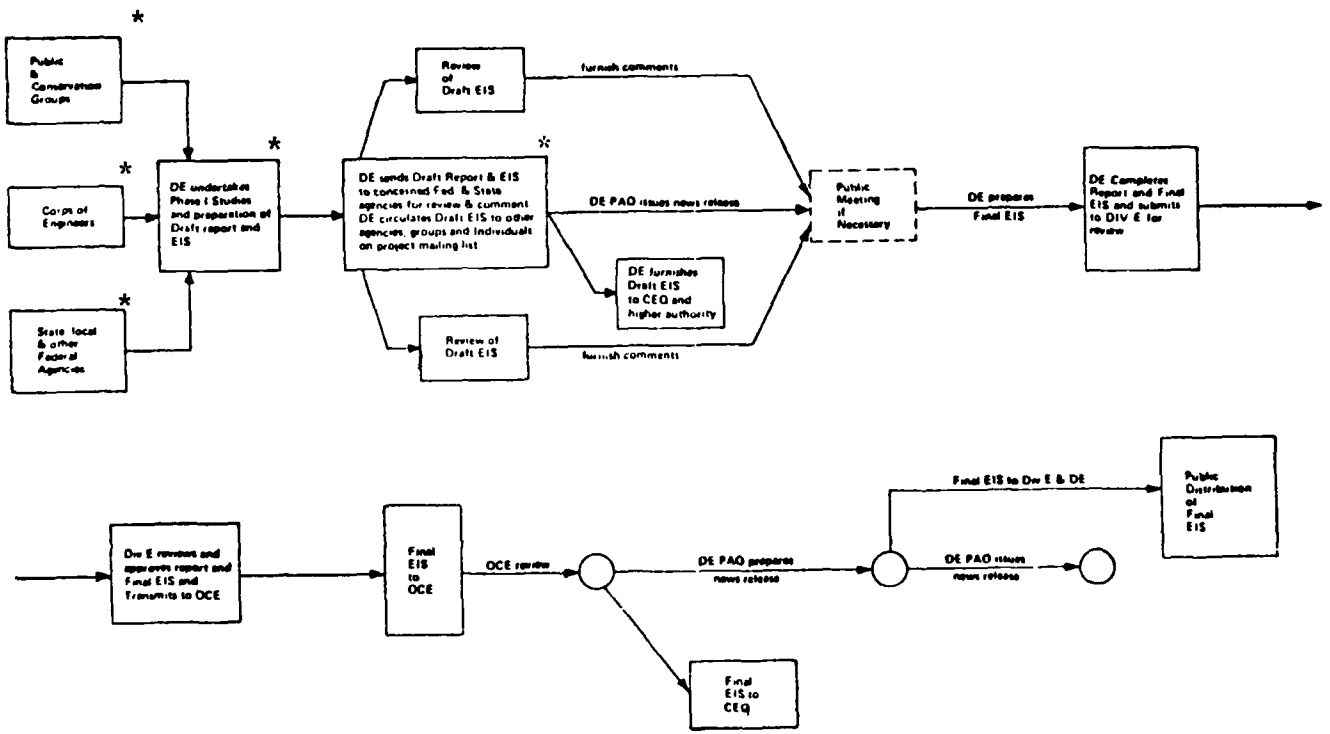
1.18 Certain costs may be singularly attributable to the mitigation measures identified in paragraph 1.13. A reasonable increase in cost is deemed acceptable if such action leads to a more environmentally-compatible project. In this regard, two specific mitigative actions will require some additional expense: the use of fill material that matches the characteristics of the native beach, and the loosening and replanting of compacted soil during clean-up operations. Additional costs associated with clean, graded fill material are dependent upon the proximity of the source, and have not been quantified as of this writing. However, it is believed that such costs would be insignificant compared with the cost of beach filling

Real estate acquisition would involve a small cost. The tilling and replanting of native soil compacted during construction operations would also incur additional cost. The cost of all mitigative measures is considered minimal compared with the total cost of the program.

1.19 There are various intangible benefits on which a dollar value cannot be placed. These include general improvement in areal aesthetics, alleviation in homeowners' concern over potential property losses, partial relief from future expenses for shore protective structures, and intangible benefits derived by shoreline alteration and stabilization (i.e., more stable vegetation, improved habitats for wildlife, etc.). These, of course, must be offset by projected losses of shoreline aesthetic value, benthic habitat, and benthic life resulting from construction.

Project Status

1.20 In order to inform the public of the process involved, the status of this project and procedural steps in the preparation of the Environmental Impact Statement (EIS) are presented in Figure 3. Section 111 of the River and Harbor Act of 1968 was approved for public law (P.L. 90-483) on 13 August 1968. An investigation of beach erosion attributable to the Federal navigation structures at Hammond Bay Harbor was requested by Michigan's Department of Natural Resources in May 1971. A preliminary Section 111 report on Hammond Bay Harbor was prepared by the Corps of Engineers in 1972. The preliminary report recommended that a Detailed Project Report (DPR) be authorized to develop plans to mitigate shore damages



*Denotes completed step.

LEGEND

DE - District Engineer
Div E - Division Engineer
OCE - Office Chief of Engineers
PAO - Public Affairs Office
CEQ - Council on Environmental Quality
OSA - Office, Secretary of the Army
EIS - Environmental Impact Statement

FIGURE 3. Chronological Procedure for Preparation and Coordination of Environmental Statement

attributable to the Hammond Bay navigation structures. A draft of the DPR was completed in June 1976; a Draft EIS was prepared concurrently and preceded this document.

1.21 Following review of the Draft EIS by concerned Federal State, and local agencies, groups, and individuals, a public workshop was held in Rogers City on September 16, 1976. The purpose of this meeting was to present a clarification of policy concerning Section 111 and the proposed project at Hammond Bay Harbor. The meeting also provided the public and all interested parties with an opportunity to express their viewpoints, ask questions, and raise issues bearing on the erosion problem. The Draft Environmental Statement was revised in response to comments received from governmental agencies and private citizens, and constitutes this document.

2. ENVIRONMENTAL SETTING WITHOUT THE PROJECT

Site Location

2.01 The Federally-constructed harbor at Hammond Bay, located in Presque Isle County, lies on the northeast shore of Michigan's lower peninsula at approximate latitude 45°36' and longitude 84°10'. The navigation structure is situated in Bearinger Township approximately 310 miles (449 km) northeast of Chicago, 21 miles (34 km) northwest of Rogers City, and 20 miles (32 km) southeast of Cheboygan. The geographic relationship of this harbor to the general area is shown in Figure 4.

2.02 Lake Huron is the second largest of the Great Lakes, with 23,000 square miles (59,570 sq km), exceeded only by Lake Superior. It is about 225 miles (360 km) long and 100 miles (160 km) wide with the main axis in a north-south direction. The maximum recorded depth is 750 feet (229 m). The low water datum--an arbitrary plane to which elevations of the Lake are referred--is 576.8 feet (175.9 m) above mean water level at Father Point, Quebec (International Great Lakes Datum, 1955). Lakes Michigan and Huron, connected by the deep and broad Straits of Mackinac, act as one hydraulic unit with the same water level.

2.03 The average elevation of Lake Huron surface water varies irregularly from year to year. In general, the Lake surface is subject to seasonal fluctuations, with the lowest stages usually prevailing during winter months and the highest during summer months. For the 111 years from 1860-1971, the difference between the highest and lowest monthly mean stages [581.94 feet

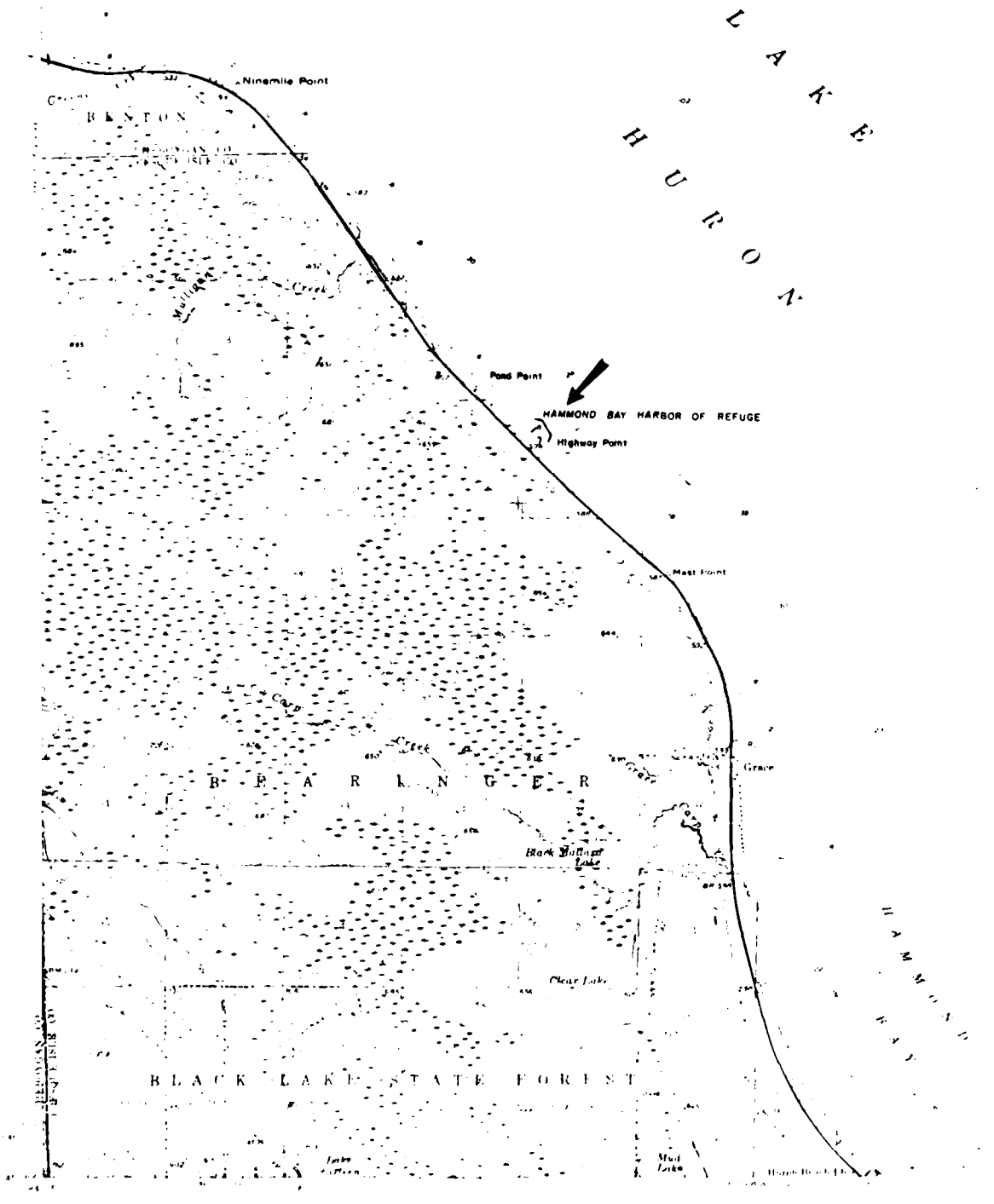


FIGURE 4. General Vicinity Map

(177.4 m) in June of 1886, and 575.35 feet (175.4 m) in March of 1964] was 6.59 feet (2.0 m). The greatest annual fluctuation based on the highest and lowest monthly means for the period of record was 2.23 feet (0.68 m) (1943); the smallest annual fluctuation was 0.36 feet (0.01 m) (1941). There are also oscillations of irregular amount and duration produced by storms and seiches. Such transient fluctuations may attain a 1.8-foot (0.54-m) rise in water level at a frequency of once per year. It is estimated that the mean lake level for 1976 should be about 580 feet (177 m). The highest recent lake level elevation occurred in 1973 at approximately 581 feet (177.2 m); mean lake levels have declined each year since.

2.04 Deep-draft harbors in the general vicinity of Hammond Bay are Cheboygan and Rogers City, located 20 miles (32 km) northwest and 21 miles (33.8 km) southeast, respectively. These two harbors, along with Hammond Bay, serve as harbors-of-refuge and also are heavily used by recreational boaters during the summer months. Other major harbors on Lake Huron are located on Michigan's shoreline at Calcite, Stoneport, Alpena, Alabaster, Bay City, Saginaw, and Port Huron.

2.05 Michigan has a total of 3,222 shoreline miles (5,187 km). In the Hammond Bay Harbor vicinity, parts of the Lake Huron shoreline are currently showing signs of erosion. Principle causes of erosion are thought to be: (a) long-term geological evolution, (b) high lake levels, (c) frequency of occurrence and intensity of storms, and (d) interference of natural processes by man-made structures. The present investigation is aimed at quantifying erosion caused by the Federal navigation structures at Hammond Bay and evaluating benefits and costs of mitigation measures.

Climate

2.06 The climatic conditions of Presque Isle County are constantly modified by the vast water expanse of Lakes Michigan and Huron. Along the shoreline the mean monthly temperature is approximately 68°F (20°C) in July and 18°F (-8°C) in January. The mean annual precipitation is approximately 33 inches (84 cm). In the summer months of June, July, and August the average precipitation is approximately 3.5 inches per month (8.9 cm/mo).

2.07 Although inland areas of lower Michigan are affected by the proximity of Lake Huron, the shoreline region is where these effects are felt most. Since the lake water is cool in the spring, it tends to retard the temperatures, thus holding back the development of vegetation until the likelihood of frost is over. In the fall, the waters, warmed by the summer sun, tend to temper the first cold waves until vegetation is mature and safe from frost. The average growing period (frost free) in the vicinity of Hammond Bay is between 140 and 150 days each year.

2.08 Detailed weather data for Hammond Bay are not available. The U.S. Department of Commerce (National Oceanic and Atmospheric Administration) maintains a climatological station in Onaway State Park, Michigan, about 11 miles (18 km) south of Hammond Bay. These records indicate that January temperatures average 18.8°F (-7.3°C) in this area, and July temperatures average 68.0°F (20°C) (see Table 1). Extremely hot and severely cold days are rare for this latitude. Precipitation for the area averages 29.6 inches (75.1 cm). September is normally the wettest month, as moisture is picked-up over the Great Lakes by the prevailing northwesterly winds and

TABLE 1. SUMMARY OF CLIMATIC AVERAGES FOR HAMMOND BAY, MICHIGAN* (1940-1970)

MONTH	MEAN TEMPERATURE °Fahrenheit (°Centigrade)		PRECIPITATION Inches (Centimeters)	
January	18.8	(-7.3)	1.66	(4.2)
February	19.4	(-7.0)	1.33	(3.4)
March	27.7	(-2.4)	1.84	(4.7)
April	42.2	(5.7)	2.51	(6.4)
May	53.2	(11.8)	2.85	(7.2)
June	63.3	(17.4)	3.04	(7.7)
July	68.0	(20.0)	2.87	(7.3)
August	66.8	(19.4)	2.83	(7.1)
September	58.6	(14.8)	3.88	(9.8)
October	49.5	(9.7)	2.34	(5.9)
November	36.0	(2.2)	2.66	(6.8)
December	24.2	(-4.3)	1.80	(4.6)
Annual Average	44.0	(80.0)	29.61	(75.1)

*Recorded at Onaway State Park.

Source: U.S. Department of Commerce, NOAA.

precipitated over adjacent lands. Summer precipitation mainly comes in the form of afternoon showers and thunderstorms, the latter occurring on an average of 31 days/yr. Snowfall is heaviest during the months from November to March, but light flurries may occur as late as May and as early as September. During an average winter in this region, snowfall totals about 59.5 inches (151 cm). Cloudiness is greatest in late fall and early winter, while sunshine percentages are greatest in the spring and summer.

Harbor History and Description

2.09 Hammond Bay Harbor serves as one of 21 harbors-of-refuge for light-draft vessels on the United States coasts of the Great Lakes. The development of harbors-of-refuge was authorized by the River and Harbor Act of 2 March 1945, as per House Document No. 446. These harbors, located not more than 30 miles (48 km) apart, are intended to provide refuge to light-draft vessels sailing between ports and to encourage recreational boating on the Great Lakes.

2.10 There were no harbor structures of any kind in the area prior to Federal construction of the Hammond Bay Refuge Harbor. Construction was initiated in 1962 and completed on 4 June 1965. The existing project consists of two rubble mound offshore breakwaters; the east breakwater is about 1,445 feet (441 m) long and the west breakwater is about 460 feet (140 m) long. The breakwaters enclose an inner harbor area of about 5.6 acres (2.3 ha). The project depths are 12 feet (4 m) for the entrance channel and 10 feet (3 m) for the inner harbor area. Figure 5 shows the existing Federal navigation project at Hammond Bay Harbor.

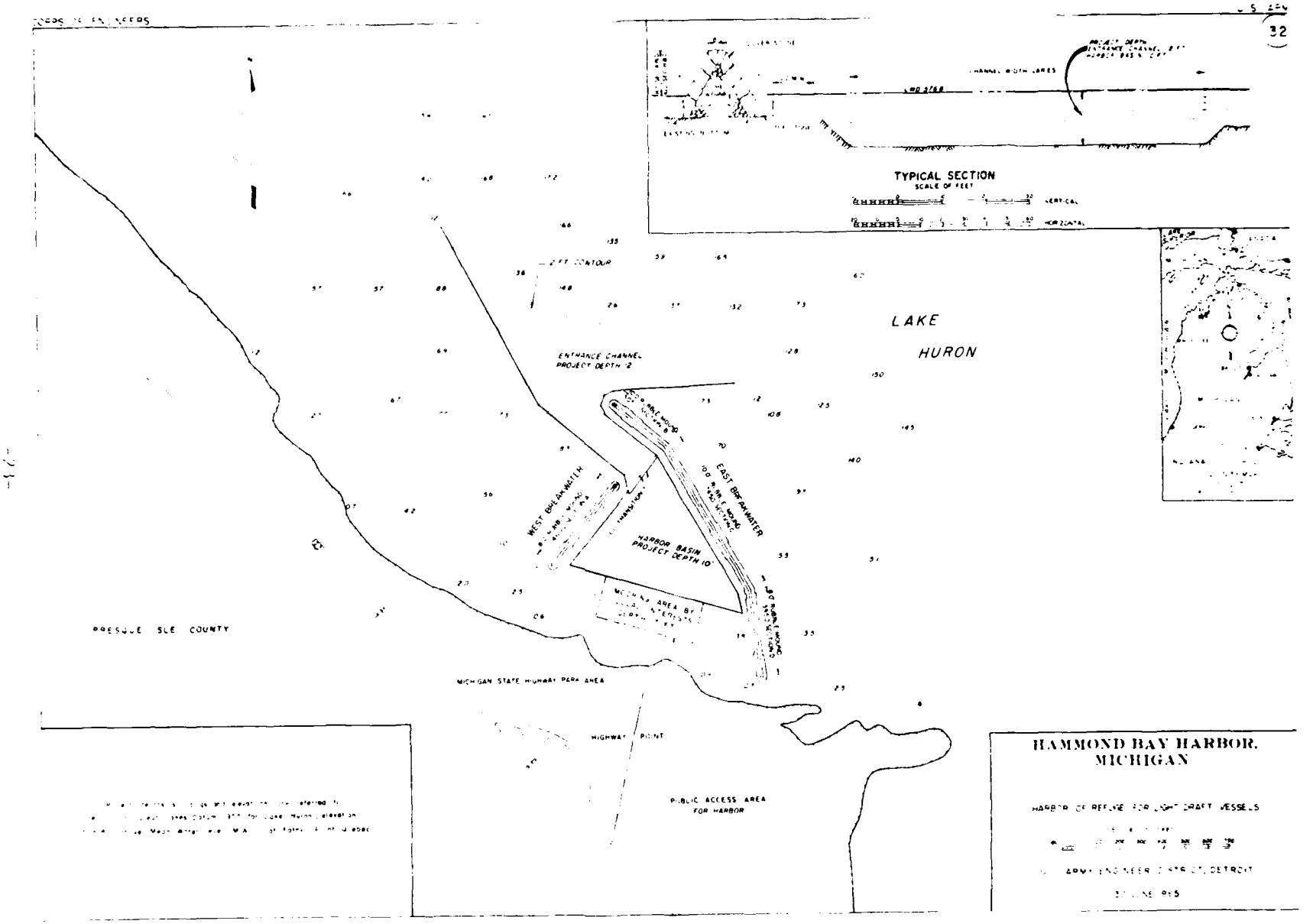


FIGURE 5. Hammond Bay Harbor Structures and Dimensions

2.11 The estimated capacity of Hammond Bay Harbor is 56 small boats when berthed fore to aft. The harbor is primarily used by recreational boats under 60 feet (18 m) in length during the months from June to September. No commercial usage occurs, but smaller commercial vessels could use the harbor for refuge during storms.

2.12 Table 2 presents recreational boating statistics for Hammond Bay Harbor and the two nearby refuge harbors at Cheboygan and Rogers City. Comparisons of data show that Hammond Bay Harbor is utilized less than the other harbors. (Cheboygan data reflect only a part of the recreational boat traffic, since boat facilities other than the State Waterways Commission docks exist within the harbor.) An average of more than 280 boats per year used the harbor during the 3-year period from 1972 through 1974. Rogers City Harbor entertained four times as many recreational boats for the same time period.

2.13 Since the initial dredging of Hammond Bay Harbor, there has been no maintenance dredging. Condition surveys for the period 1966-1974 indicate only a small amount of shoaling inside the harbor and in the entrance channel.

Areal History

2.14 Europeans first discovered the Great Lakes Region when Samuel de Champlain visited the area in July 1615. The Frenchman, Jean Nicolet, was the first white man to record his discovery of Lake Michigan in 1634. The Northwest Territory, including Michigan, was first settled by French hunters, trappers, and lumbermen in the early 18th century. In 1805, the Michigan Territory was created. The timber

TABLE 2. COMPARATIVE RECREATIONAL-BOAT USAGE STATISTICS

LOCATION	YEAR	NUMBER OF BOATS	BOAT DAYS	USER DAYS
HAMMOND BAY HARBOR	1972	243	401	903
	1973	414	500	1,365
	1974	203	290	725
CHEBOYGAN* HARBOR	1971	420	-	1,335
	1972	363	593	1,083
	1973	248	282	768
ROGERS CITY HARBOR	1971	1,092	2,861	4,084
	1972	1,040	3,464	3,639
	1973	1,221	3,500	3,865
	1974	1,101	4,311	3,663
	1975	1,260	4,848	3,911

* As recorded at State Waterways Commission Docks.

Source: Department of Natural Resources, Waterways Commission

trade was king until the end of the 19th century when the forests were depleted; the economy then switched to one of wholesale and retail trade, dairying and fruit growing.

2.15 Modern settlement of Presque Isle County began in 1869 when German and Polish immigrants settled along the Lake Huron shore. In 1871 Presque Isle became an independent county. The population of Presque Isle steadily increased from approximately 3,500 in 1880 to a peak population of about 13,000 in 1960.

2.16 Rogers City, now the county seat, was incorporated as a village in 1877. Onaway, further inland, was not incorporated as a village until 1889. Its growth was more rapid than that of Rogers City, and it became a city in 1903.

2.17 Rogers City is known as the home of "the world's largest limestone quarry," located in the southeast corner of Rogers Township and extending into the northwest section of Pulawski Township. The city also has a small boat harbor. Presque Isle County Airport is situated in the southern section of Rogers City. There are no other urban centers in the immediate vicinity of Hammond Bay.

Historical, Landmark, and Archaeological Sites

2.18 The National Register of Historic Places (Federal Register, Vol. 40, No. 4) including its June 1976 supplement, has been consulted. One officially registered historical site has been identified in Presque Isle County: the Old Presque Isle Lighthouse at Presque Isle Harbor, located 20 miles

(32 km) south of Rogers City. No other properties within the County have been determined to be eligible for inclusion in the National Register. Furthermore, there are no properties possessing historical, architectural, or cultural value located within the area of the project's potential environmental impact. The State Historic Preservation Officer has been contacted and concurs that, based on the preliminary assessment, the project will not affect the site listed in the National Register or any other site of historical interest*.

2.19 The National Register of Natural Landmarks (Federal Register, Vol. 40, No. 87) and its June 1976 supplement have been consulted. No registered, eligible, or pending sites are listed for Presque Isle County.

2.20 During the preparation of this statement, the State Archaeologist was contacted for information regarding the specific locations of known or potential archaeological sites in the Hammond Bay Harbor vicinity. Detailed archaeological data in Presque Isle County is scarce, and no specific sites were listed within the project area. Specific information, if available, would be withheld because it is believed that such knowledge in a publicly-available document might be tantamount to an invitation for site tampering by unauthorized individuals. It should be noted that, in response to the Corps' mandate for Recording and Preserving Historical and

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*Telephone Communication, 18 June 1976.

Archaeological Finds within its project areas, all items having any apparent historical or archaeological interest which are discovered in the course of any construction activities shall be carefully preserved. The archaeological find shall be left undisturbed and the proper authorities shall be notified.

2.21 The State Archaeologist, following a preliminary assessment of the project, sees no further need for additional archaeological surveys in the vicinity of Hammond Bay Harbor and concurs that the proposed project will not affect cultural sites of paleontological, archaeological, or historical interest.*

Demography

2.22 Presque Isle is one of the least populated counties in Michigan. While the state grew at a rate of 22.8% from 1950 to 1960, Presque Isle County gained population at a rate of 9.3% (see Table 3). State Economic Area 4, which includes the northern counties of Michigan's lower peninsula, is a 24-county analytical unit with Newaygo and Mecosta Counties at the southernmost limit and Lake, Wexford, Kalakaska, and Antrim as the westernmost counties of the unit. The Economic Area gained 9.3% of its 1950 population from 1950-1960.

*Telephone Communication, June 18, 1976.

TABLE 3. POPULATION TRENDS (1950-1990)

AREA	1950	1960	1970	1990	PERCENT CHANGE		
					1950-1960	1960-1970	1970-1990
State of Michigan	6,371,766	7,283,194	8,875,083	10,499,141	22.8	13.4	18.3
State Economic Area-4	258,134	282,097	338,204	354,356	9.3	19.9	63.9
Presque Isle County	11,996	13,117	12,836	19,438	9.3	-2.1	51.4
Rogers City	3,873	4,722	4,275	-	21.9	-9.5	-
Bearinger Township	-	50	67	-	-	34.0	-
Cheboygan County	-	14,550	16,573	32,393	-	13.9	95.5
Alpena County	-	28,556	30,708	43,994	-	7.5	43.3
Montmorency	-	4,424	5,247	6,655	-	18.6	26.8

*Projection by Planning and Policy Analysis Division, Michigan Department of Management & Budget, 1974.

Source: U.S. Bureau of the Census, 1950-1970.

However, from 1960 to 1970, the state population growth rate was at 13.4% and Presque Isle County lost 2.1% of its population. Population projections for the period 1970 to 1990 indicate that Presque Isle County will gain an additional 51.4% population, with an increase to 19,438.

2.23 Between 1950 and 1960, the population of Rogers City increased 21.9%; during the period 1960 to 1970 the population declined by 9.5%. Bearinger Township realized a 34.0% increase between 1960 and 1970, though the population was very sparse at 50 persons in 1960 and 67 persons in 1970. For comparative purposes, the nearby counties of Cheboygan, Alpena, and Montmorency have been included in Table 3. As shown, all three counties experienced population increases between 1960 and 1970 of 13.9%, 7.5%, and 18.6%, respectively; population projections further indicate increases of 95.5%, 43.3%, and 26.8%, respectively.

2.24 Based on 1950 population figures, Presque Isle County experienced a sizable net migration loss between 1950 and 1960 of 9.8% of the resident population (see Table 4). Between 1960 and 1970, the County experienced a net out-migration at about 12 persons per 100 resident 1960 population. Population growth due to natural increases (births minus deaths) for the two decades dropped 57% from the 1950-1960 period to the 1960-1970 period. This resulted in a total growth from 1950 to 1960 of 1,121 persons; the county population actually declined from 1960 to 1970 by 281 persons.

2.25 The State Economic Area-4 had a net migration rate of -5.2% from 1950 to 1960, indicating a loss of 13,406 people from the 24-county area. However, the natural increase of

TABLE 4. COMPONENTS OF POPULATION GROWTH (1950-1970)

AREAL UNIT	NET MIGRATION (ABSOLUTE RATE)	NATURAL INCREASE (Births Minus Deaths)	TOTAL GROWTH
1950-1960			
Presque Isle	-1,181(-9.8%)	2,302	1,121
State Economic Area-4	-13,406(-5.2%)	37,369	23,963
Michigan	156,171(2.5%)	1,295,257	1,451,428
1960-1970			
Presque Isle	-1,584(-12.1%)	1,303	-281
State Economic Area-4	28,408(10.1%)	27,699	56,107
Michigan	27,236(0.3%)	1,041,697	1,051,889

Source: U.S. Bureau of the Census, Current Population Reports, Series P-23, No. 7, November 1962.
U.S. Bureau of the Census, Current Population Reports, Series P-25, June 1971.

37,369 births minus deaths gave the Economic Area a total growth of 23,963. From 1960 to 1970, the Economic Area experienced a net migration of 10.1%, which totaled 28,408 persons. Along with the natural increase of 27,699, the total growth for the period 1960 to 1970 was 56,107 persons.

2.26 The State, as a unit, had a net migration of 2.5% or 156,171 people from 1950 to 1960. The natural increase for the same period was 1,295,257, which yielded a total growth figure of 1,451,428. The population increase from 1960 to 1970 was only 17% of the previous decades growth at 27,236 people, which equalled only 0.3% of the 1960 population. The natural increase, however, was 1,041,697 allowing the State a total growth of 1,051,889.

2.27 Presque Isle County has experienced only a minimal amount of population build-up and concentration. Population densities within the county averaged only 19.8 persons per square mile (7.6 persons per sq km) in 1970. This value is substantially lower than the state density level of 156.2 persons per square mile (60.3 persons per sq km) for the same year. Presque Isle County's urban population (employing U.S. Bureau of the Census definition) was 33.3% in 1970, which represented a 2.7% decrease from the 1960 total. These levels were substantially below the State level as a whole. In 1960 and 1970, nearly 75% of the State's population was living in urban areas.

2.28 A view of population mobility for those people 5 years of age and over and residing in the study area in 1970 is provided in Table 5. Thirty-two percent of Presque Isle County's

TABLE 5. RESIDENTIAL MOBILITY STATUS (1965 to 1970)

AREAL UNIT	PERCENT LOCAL MOVERS[a]	PERCENT MIGRANT [b]	PERCENT MOBILE[c]
Presque Isle County	16.5	15.5	32.0
Rogers City	20.7	10.5	31.2
Remainder of County	14.3	13.1	32.4
State Economic Area 4	16.5	25.4	41.9
Michigan	23.8	15.5	39.3

[a]Local movers are those individuals, 5 years of age and over, who resided in a different house in 1965 from that in which they were residing in 1970 but within the same County.

[b]Migrants are those individuals, 5 years of age and over, who resided in a different County in 1965.

[c]The mobile population consists of those individuals, 5 years of age and over, who were either local movers or migrants.

Source: U.S. Bureau of the Census, Census of Population: 1970.

resident population in 1970 had changed residence between 1965 and 1970 compared to 42% for the economic area and 39% for the State. About 15.5% of Presque Isle County's population had migrated into the county from another area in the State or Nation, while 16.5% had changed residence within the County itself. The percentage of migrants in Presque Isle's population (15.5%) was substantially below that of the economic area as a whole (25.4%), but there was no difference in the level of local mobility between the two areas.

2.29 There was virtually no difference in the level of overall mobility between Rogers City and the remainder of the Presque Isle population (31.2 and 32.4% respectively). However, these overall figures mask differences in the patterns underlying overall mobility. Mobile individuals in Rogers City were twice as likely to consist of local movers (20.7%) than migrants (10.5%). In the remainder of the County, 18% of the population 5 years of age and over were migrants, while slightly more than 14% were local movers. Fifty-eight percent of Presque Isle's local movers and 77% of its migrant population lived outside of Rogers City in 1970. The above data indicate a combination of shuffling of population within Rogers City, movement out of Rogers City to the surrounding suburban areas, and a greater tendency for people migrating into the County to reside outside of Rogers City.

Industrial Activity

2.30 The Presque Isle County resident labor force is heavily dependent on mining (see Table 6). One out of five labor force members are engaged in mining, compared to less than 2%

TABLE 6. INDUSTRIAL STRUCTURE: 1970

INDUSTRY	AREAL UNITS			MICHIGAN
	ROGERS CITY	PRESQUE ISLE COUNTY	STATE ECONOMIC AREA 4[a]	
Construction	2.6	6.4	7.5	4.8
Manufacturing	7.2	12.2	26.8	36.0
Transportation, communication and public utilities	4.8	4.5	5.1	5.2
Wholesale & retail trade	17.3	16.8	21.2	19.4
Finance, insurance, real estate business & repair service	4.6	4.2	4.5	6.6
Professional and related services	24.0	16.3	18.0	17.7
Public Admin.	8.2	4.4	4.4	3.8
Personal services	31.3	3.4	5.3	3.6
Entertainment and recreation services		0.2	0.5	0.7
Mining		19.5	1.5	0.4
Agriculture, forestry & fishing		12.1	5.4	1.8
TOTAL	100.0	100.0	100.0	100.0

[a]Percentage distribution for State Economic Area 4 derived by summing absolute county totals for each category and then calculating respective percentages.

Source: U.S. Bureau of the Census, Census of Population: 1970.

for the entire economic area and only about 0.5% for the State of Michigan. Likewise, labor force participation in agriculture and related industries (12.1%) is more than twice that of the economic area (5.4%) and nearly seven times that of the State (1.8%). In sum, extractive industries provide employment for nearly one out of every three labor force members in Presque Isle County. On the other hand, employment in manufacturing, wholesale and retail trade, and professional and related services is below that of the economic area and State, this being especially the case with manufacturing employment. Slightly more than 12% of Presque Isle County's resident labor force was in manufacturing in 1970 compared to nearly 27% in the economic area and 36% in the State. In order of predominance, the County's major industries are:

1. Mining;
2. Wholesale and retail trade;
3. Professional and related services;
4. Manufacturing;
5. Agriculture, forestry and fishing;
6. Construction;
7. Transportation, communication, and public utilities;
8. Public administration;
9. Finance, insurance, real estate, repair services;
10. Personal services;
11. Entertainment and recreational services.

2.31 The relative participation of the Rogers City labor force in manufacturing is even lower than that of Presque Isle County. Only about 7% of the resident work force in Rogers City is

employed in manufacturing industries. Meanwhile, nearly one-fourth of the city's labor force is involved in professional and related services. Seventeen percent is engaged in wholesale and retail trade. Participation in wholesale and retail trade and especially professional and related services in Rogers City is above that for Presque Isle County as a whole. Detailed data on industrial employment in personal services, entertainment and recreation services, mining and agriculture is not available for Rogers City; nonetheless, one out of three labor force members in Rogers City work in these industries. It is likely, however, that the bulk of these people are engaged in mining, given the predominance of mining in the industrial structure of the County.

2.32 The history of settlement and agricultural development in Presque Isle County is closely connected with lumbering which began on a large scale in the decade 1870-1880. The first land to be logged was that covered by pine forests, most of which were removed by 1900. The lumbering of hardwoods and swamp timber followed between 1900 and 1930. It was during this later period that most of the agricultural development took place because the hardwood lands were regarded as the best land, and farms were established immediately following lumbering.

2.33 Within the last five years, the County showed no oil or gas production. However, data indicated that 3,339 barrels of oil were produced within the County in 1969.

Occupational Structure

2.34 Blue collar occupations involved more than two of every five work force members in Presque Isle County and the economic area in 1970 (see Table 7). This was roughly comparable to the figure for the State. However, more than 11% of Presque Isle's labor force was engaged in farming which was nearly three times the participation rate for the economic area and nearly eight times that of the State. Thirty-five percent of the resident labor force in Presque Isle was pursuing white collar occupations compared to 39% for the economic area and 45% for the State. Participation in service occupations (11.2%) was also below that of the economic area and the State. Three out of four blue collar workers were employed as craftsmen, foremen, or nontransport operatives. Forty percent of white collar workers were in professional technical, and kindred occupations.

2.35 In contrast to the County as a whole, one of every two labor force members in Rogers City was engaged in white collar occupations. Thirty-six percent of Rogers City's work force was in blue collar occupations and 20% in service occupations. Distributions within these major occupational groups in Rogers City approximated that of the entire County with professional, technical, and related occupations dominating white collar employment, and craftsmen, foremen, and nontransport operatives dominating the blue collar jobs.

TABLE 7. OCCUPATIONAL STRUCTURE (1970)
(% of total)

OCCUPATION	ROGERS CITY	PRESQUE ISLE COUNTY	STATE ECONOMIC AREA 4[a]	MICHIGAN
WHITE COLLAR	49.8	34.9	38.8	44.9
Professional, technical & kindred	22.3	13.9	11.6	14.2
Managers & admin. (exc. farm)	7.8	6.7	8.3	7.0
Sales workers	5.6	4.5	6.1	6.8
Clerical & kindred	14.1	9.8	12.1	16.9
BLUE COLLAR	36.3	42.5	41.7	40.7
Craftsmen, foremen, & kindred	16.0	16.8	15.4	15.4
Operatives (exc. transport)	10.5	14.4	16.4	17.5
Transport equip. operatives)	3.7	5.6	4.5	3.8
Laborers (exc. farm)	6.1	5.7	5.4	4.0
FARM	0.0	11.4	4.5	1.5
Farmers & farm managers	0.0	6.7	3.2	1.0
Farm laborers & farm foremen	0.0	4.7	1.3	0.5
SERVICE	19.9	11.2	15.0	12.9
Service workers	13.5	10.3	13.6	11.9
Private household workers	6.4	0.9	1.4	1.0
TOTAL	100.0	100.0	100.0	100.0

[a]Percentage distribution for State Economic Area 4 derived by summing absolute county totals for each category and then calculating respective percentages.

Source: U.S. Bureau of the Census, Census of Population: 1970.

Physiography and Geomorphology

2.36 Michigan's lower peninsula varies in elevation from 400 to 1,700 feet (122-519 m) above sea level. The physiography is typical of a glaciated area marked by moraines, outwash plains, kames, kettle holes, and eskers. The topography of the lower peninsula, although generally undulating and rolling, is characterized by a variety of linear ridges and cliffs, plateaus, rock knobs, u-shaped valleys, and broad, flat plains. Michigan owes the basis of its soils to the effects of glaciation. Morainic, fluvial, and lacustrine deposits predominate in this region. Underlying bedrock includes Cambrian and Ordovician dolomite, limestone, shale, sandstone, and granite.

2.37 Current topographical features, including the extent of surface water in the Hammond Bay region, have resulted from Ice Age events (the latest Ice Age terminated 9,500 years ago). The flat and undulating areas were formed as glacial outwash, till, or lakebed plains, while the hills are largely of morainic origin. Swamps are widely distributed and form an intricate network pattern when mapped in detail. The streams, for the most part, originate in and flow through swamps and have not cut deep channels nor developed dendritic forms. Consequently, little natural drainage of the original wet and left by glaciation has taken place, and there has been little development of alluvial bottomland along the stream courses. Three large lakes (Black, Grand, and Long Lakes) occupy basins on the bedrock of the County. In addition, there are several small lakes occupying basins and limesinks in the moraines and outwash plains in the southwestern part of the County.

2.38 The bulk of the geologic units are lithified relics of ancient seas that occupied the interior of the continent in the many millions of years of earth history prior to the advent of man. These units have been gently folded by earth forces and dip eastward toward the center of a large structural basin that underlies the State of Michigan. The lithified sediments, or bedrock, lie buried beneath a cover of more recent sands and clays.

2.39 The bedrock underlying the northeastern part of Michigan's lower peninsula consists of Lower Mississippian and Upper and Middle Devonian Series of the Paleozoic Era. The bedrock of Presque Isle County consists of Middle Devonian, including Traverse Group, Rogers City and Dundee limestones, Detroit River Group, and Bois Blanc Formation. Two major classes of soils predominate in Presque Isle County. Mineral soils, developed from glacial material under various moisture conditions and differences of vegetation, comprise about 85% of the area. Organic soils (peats and mucks) comprise the remaining 15% of this region.

Hydrology

2.40 Lake Huron has a surface area of 23,000 square miles (59,570 sq km). It is about 247 miles (395 km) in length and 100 miles (160 km) wide with the main axis in a north-south direction. The maximum recorded depth is 750 feet (229 m). Low water datum for Lake Huron is 576.8 feet (176 m) above mean water level in the Gulf of St. Lawrence at Father Point, Quebec. At the Straits of Mackinac, Lake Michigan waters flow into Lake Huron; the St. Marys River flows from

Lake Superior into the northern end of Lake Huron. Port Huron, at the southern end of Lake Huron, is the point of outflow.

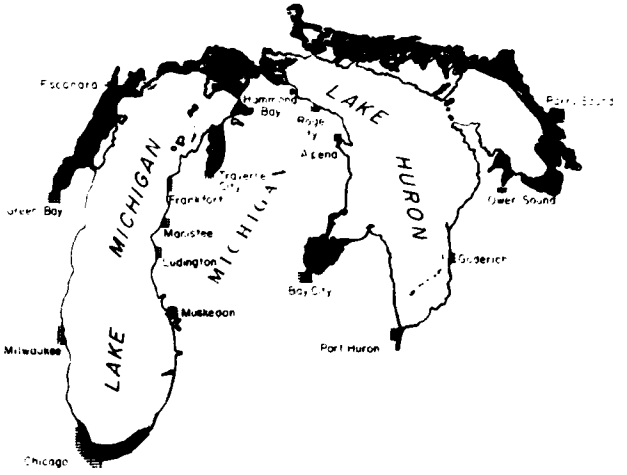
2.41 Lakes Michigan and Huron, connected by the deep and broad Straits of Mackinac, act as one hydraulic unit with the same water level. The level of Lake Huron fluctuates from month to month as well as from year to year. These fluctuations depend upon the volume of water entering and leaving the Lake. In addition, there may be daily and even hourly fluctuations, known as seiches, that result from a tilting of the Lake surface by winds and barometric pressure differences. The lowest seasonal lake levels prevail during winter months, and the highest levels prevail in summer months. The greatest annual fluctuation of the highest and lowest monthly means has been about 2.3 feet (0.69 m). Water releases from Lake Superior, Lake Ontario, and through the Chicago Diversion Canal are artificially controlled in accordance with a plan developed by the International Joint Commission.

2.42 Ice formation in Lake Huron begins about the last week of January and continues until about the third week of March (see Figure 6). Normally, the greatest extent of ice cover occurs between the 15th and 25th of March and covers about 40% of the Lake surface. During a severe winter, ice may cover 80% of the Lake. Ice forms in the northwest first and then accumulates in a southerly direction. Likewise, spring thaws begin in the south and proceed north. Circular surface current patterns of the southern basin distribute drifting floes along the shore. During a mild season, the drift ice is consolidated and can extend from the shore out into the lake a distance of 12 to 15 miles (19-24 km). The distribution of ice, particularly pack-ice, is governed by wind and current patterns.

EARLY ICE COVER

JANUARY 25 - FEBRUARY 5
LAKE MICHIGAN

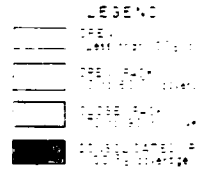
JANUARY 25 - FEBRUARY 5
LAKE HURON

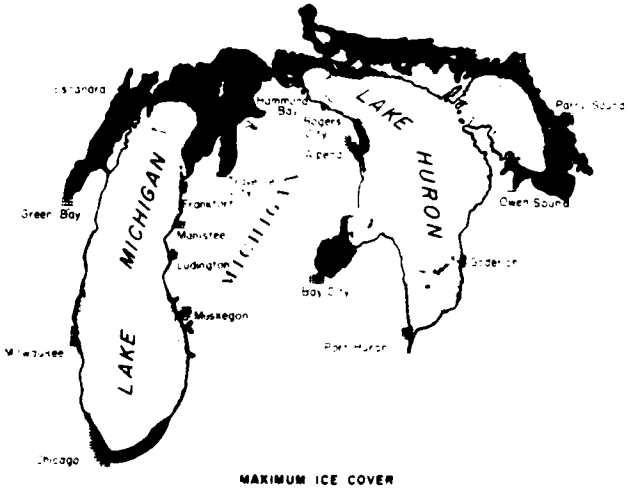


MID SEASON ICE COVER

(FEBRUARY 20 - FEBRUARY 28)
LAKE MICHIGAN

(FEBRUARY 25 - MARCH 5)
LAKE HURON

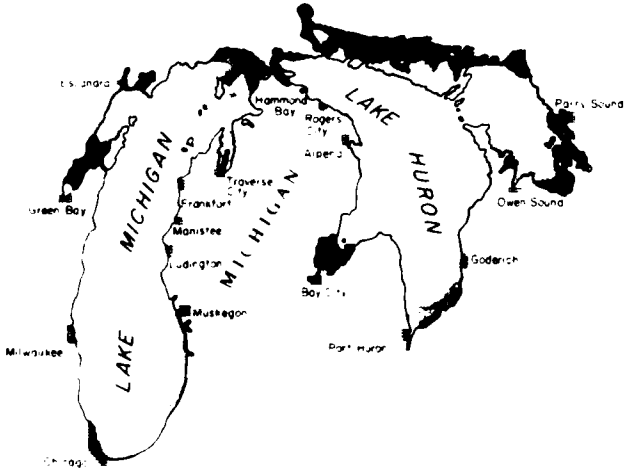




MAXIMUM ICE COVER

MARCH 5 - MARCH 25
LAKE MICHIGAN

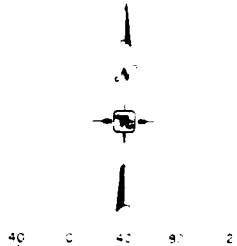
MARCH 5 - MARCH 31
LAKE HURON



EARLY DECAY PERIOD

MARCH 25 - MARCH 31
LAKE MICHIGAN

MARCH 5 - APRIL 5
LAKE HURON



Source: Great Lakes Ice Atlas
Lake Survey Center, '97

FIGURE 6. Normal Ice Cover, Lakes Michigan and Huron

2.43 Lake Huron also has large areas that are protected from deep lake currents. These areas are the North Channel, which is one of the first areas to become ice-covered, and Georgian Bay, which tends to react to ice formation as an individual lake. Georgian Bay has the characteristic accumulation of shore ice and ice-cover found in the bays and harbors. As the winter progresses, the growth of the ice-cover extends toward the middle areas. Lake Huron proper has three areas that form and accumulate extensive ice-covers early in the season. The areas are the Straits of Mackinac in the north, Saginaw Bay, and the southern basin in the Port Huron area.

2.44 Michigan's major drainage areas emptying into Lake Huron from Cheboygan County down to Arenac County include the Cheboygan River, the Presque Isle Complex, Thunder Bay River, the Alcona Complex, Au Sable River, and the Rifle-Au Gres Complex. Three of the largest lakes within Presque Isle County rank in size within the top twenty for the State of Michigan. Black Lake is eighth largest, with 10,130 acres (4,103 ha), has a maximum depth of 50 feet (15 m), and 18.7 miles (30 km) of shoreline. Grand Lake, ranking nineteenth, is comprised of 5,660 acres (2.292 ha), with a maximum depth of 25 feet (8 m) and 35.5 miles (57.2 km) of shoreline. Long Lake, ranking twentieth, has 5,652 acres (2,289 ha), a maximum depth of 25 feet (8 m), and 25.3 miles (40.7 km) of shoreline.

2.45 In the vicinity of the Hammond Bay Refuge Harbor lies Black Mallard Lake, located about 3.8 miles (6.1 km) south of the harbor in Bearinger Township. One small, unnamed stream enters Lake Huron just south of the proposed construction site; there are no inland waterway connections in the vicinity of the harbor.

Shoreline Description

2.46 Michigan's lower peninsula has about 634 miles (1,021 km) on Lake Huron with slightly over half classified as non-erodible. Of the erodible shoreline, almost 100 miles (161 m) have been designated as high-risk areas. Cheboygan, Presque Isle, and Alpena Counties together have only 1 mile (1.6 km) of designated high-risk shoreline. Much of this shoreline is classified as non-erodible and although extensive areas are suffering from slight erosion, homes and large amounts of property are not generally threatened.

2.47 The Presque Isle shoreline in the vicinity of Hammond Bay is generally a sandy, coastal lowland backed by a level sand plain. The waterline is characterized by sands and gravels in varying amounts and textures up to 6 inches (15.2 cm) in diameter. The dry beach is usually 25 to 50 feet (8-16 m) wide with a shallow 1:10 slope. There is virtually no bluff to speak of and vegetation, such as beach grass, willow, aspen, and pine, is often found close to the waterline.

2.48 Hammond Bay Harbor lies about 3 miles (4.8 km) northwest of Hammond Bay on a reasonably straight shoreline which bears NW from Mast Point (near the settlement of Grace) about 5 miles (8 km) to Ninemile Point (near the Cheboygan-Presque Isle County line). The shoreline is interrupted by numerous small pocket beaches and small bays separated by boulder- and cobble-strewn points. The navigation structure lies at the south end of one of the bays which is bounded by two points about 0.75 miles (1.2 km) apart. The southerly of these two points is called Highway Point. It is within this bay that the greatest concern over harbor-induced erosion exists.

2.49 In order to facilitate discussion of the shoreline, the coastal environment near Hammond Bay has been divided into three reaches (see Figure 7). From north to south, they are:

Reach 1 - The Cheboygan County Line to Pond Point;

Reach 2 - Pond Point to Highway Point;

Reach 3 - Highway Point to Mast Point.

2.50 Reach #1 comprises about 2.5 miles (4.0 km) of beach running in a southwesterly direction from the Cheboygan County Line to Pond Point. A pattern of alternating points and cusps characterize this zone, where beach widths vary from a maximum of 60 feet (18.3 m) within the cusps to nearly nothing near the points. Gravel is present along the plunge line of these sand beaches; cobbles and boulders dominate the offshore region. Vegetation in this area consists of beach grass with some shrubbery out to the water line. Erosion and accretion appear to be basically balanced in this reach.

2.51 Reach #2 lies between Pond Point and Highway Point, a distance of 0.8 miles (1.3 km), and contains Hammond Bay Harbor. Pond Point is covered with gravel, cobbles, and boulders (see Plate 2). At low water, much of the point is exposed as it slopes very gently lakeward. The point itself is apparently stable and acts as a substantial littoral barrier. The point leads into a sandy beach a short distance to the south, where the beach widens to a maximum of about 50 feet (15.2 m). At the southern limit of this beach a low sand bluff begins to take shape and first evidences of erosion appear.

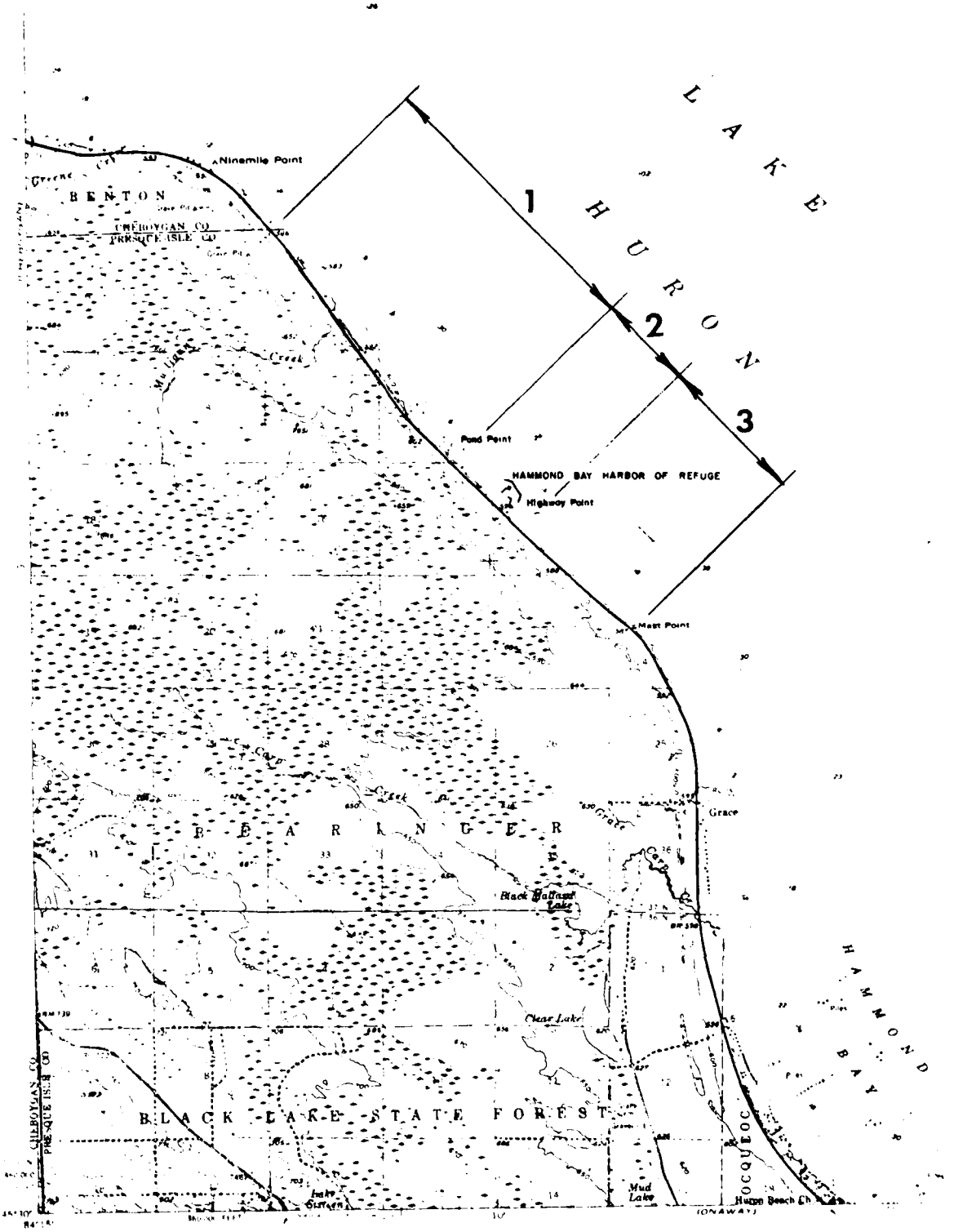


FIGURE 7. Hammond Bay Harbor and Vicinity, Definition of Shoreline Reaches

Area of most severe erosion about 1,000 feet north of harbor June 1976

Remains of private structure situated in vicinity of most severe erosion. June 1976

Private shore protection works 1,200 feet north of harbor December 1975

Rocky beach north of private shore protection December 1975

Southerly flank of Pond Point December 1975

Shoreline north of Pond Point December 1975

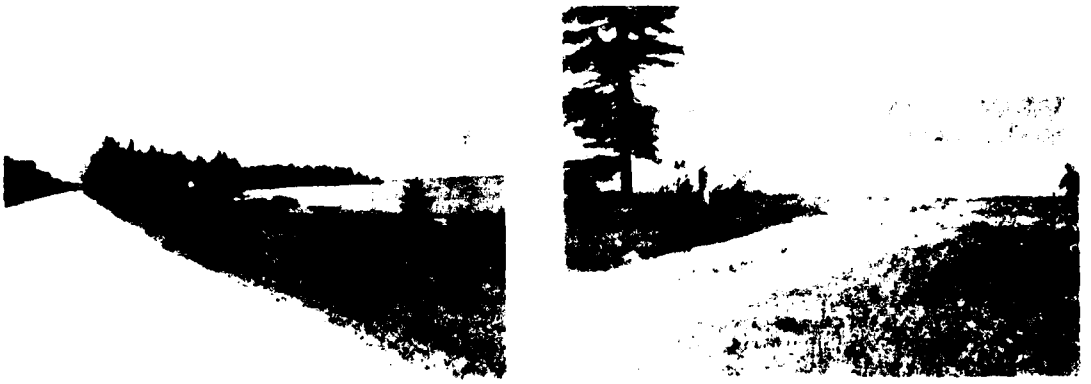
Plate 2. Shoreline conditions on Lake Huron north of Hammond Bay Harbor

2.52 Continuing southward, the bluff is sustained by shore protective works in front of a residential structure. Just south of these works [about 1,200 feet (366 m) north of the harbor], the shoreline has receded about 50 feet (15.2 m) to form a pocket of erosion. The sand and gravel beach sweeps southward and varies from zero to 10 feet (0-3.1 m) in width with gravel prominent along the plunge line. From the crest of the bluff there is very little increase in elevation back to the centerline of U.S. Route 23, which at one point is only about 100 feet (31 m) from the shoreline.

2.53 The shore in the vicinity of proposed construction is shown in Plate 3. Obvious erosion continues south of the aforementioned shore protection structures (shown in the bottom two photographs) for about 450 feet (136 m). From there, the shoreline sweeps along an accreting beach into the harbor area (top photos). Between the road and the low bluff crest at the eroding beach there is little vegetation, only a few trees, and an unobstructed view of Lake Huron. A short access road (middle photos) leads to the sunken foundation of a residential structure that has already succumbed to continuing erosion (partially shown in bottom-left photo). This existing road is proposed for use during beach-fill operations.

2.54 The shoreline within the harbor area consists of low-rolling sand dunes backing a sand beach. A sand spit has formed opposite the inner end of the west breakwater (see Plate 4). The plunge line of the beach is gravel with some cobbles. The State has developed a small boat docking and harbor area. The adjacent land area has been filled and is well protected by heavy riprap. At the southern end of the harbor a point extends lakeward from the low-rolling plain.

Vicinity of Proposed Groin

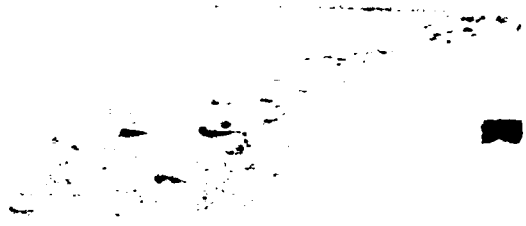


Region between highway and shoreline in proposed construction area

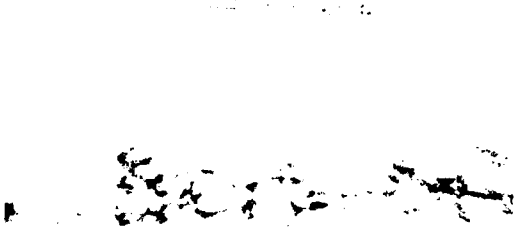
Erosion damage area proposed to be filled

Plate 3. Shoreline conditions in area of proposed mitigation measures. June 1976

Beach south of Highway Point
June 1976

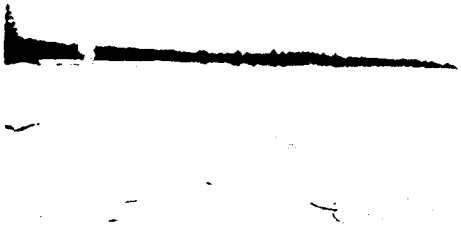


Northerly flank of Highway Point
December 1975



Typical breakwater section
December 1975

Shoreline and drainage behind
north fillet area. June 1975



North fillet beach
December 1975

Accreted sand spit between west
breakwater and shore

Plate 4. Shoreline conditions on Lake Huron near Hammond Bay Harbor

The short segment between the point and the harbor appears to be reasonably stable, being sheltered from waves from any direction other than directly offshore.

2.55 The third shoreline reach lies to the south of Hammond Bay Harbor and is apparently separated from any major effects of the harbor structures by Highway Point. The presence of numerous cobbles and the underlying hard-pan clays appear to prevent the point from eroding. As the shoreline sweeps around Highway Point there is no evidence of any active erosion. In fact, based on interpretation of the 1963 aerial photographs, the beach between Highway Point and Mast Point appears to have served as a borrow site for sand at the time of harbor construction. In the bay, the sand beaches range from 10 to 40 feet (3-12 m) in width. Vegetation in the area is extensive and in some locations directly contacts the Lake. There is little or no residential development along this apparently stable reach.

Shoreline Processes

2.56 Principle causes of erosion deal with natural forces and shoreline characteristics. Natural forces particularly responsible for Michigan's shoreline erosion include storms, high lake levels, wave action, frost and ice, underground water seepage, and surface-water runoff. Major storms contribute heavily to shoreline erosion. Except where bedrock is exposed or protective works have been constructed, most of Michigan's lower peninsula is vulnerable to shore erosion.

2.57 The direction, magnitude, and duration of Lake Huron storms have considerable influence on shore erosion. Should a storm persist, waves can build up to great heights and if superimposed upon high lake levels, may result in unusually high water levels. High lake levels due to storms at one end of a lake are usually accompanied by lower levels at the opposite end. Winds, particularly of storm velocity, and sharp gradients in barometric pressures over short distances can cause a wide range of lake-level fluctuation. Bluff recession rates are much greater during high lake levels, but erosion continues during low-water periods.

2.58 Wave action works directly on the beach or at the toe of the bank, eroding clay, silt, sand, and gravel. This erosion increases when lake levels rise because the beaches are narrower or submerged, and the waves are able to directly attack the bluffs or the unprotected toe of the bank. Thus, a wide beach is the best protection the upland shore can have against wave attack.

2.59 Surface-water runoff and groundwater seepage carry large amounts of erodible material, particularly where barren, steep-sloped bluffs exist. Seepage often occurs through sandy layers in glacial-till bluffs. Underground water seepage from exposed bluffs or unstable material may cause slumping and further weaken the bluff structure.

2.60 One of the most severe threats to the shore is erosion by frost and ice. In certain of the fine-grained silty soils comprising shoreline bluffs, the alternating freezing and thawing can weaken the soil, resulting in sloughing. Frost and ice formation within clay fissures, glacial tills, or shale

bluffs may contribute to erosion. Damage may be caused by shore ice when broken up and driven onto beaches by onshore storms; lake-bottom material may be scoured-out and structures damaged by drift ice. Shore ice can also be of benefit as protection against wind and wave erosion by winter storms.

Erosion History and Status

2.61 A third of the Great Lakes shoreline is subject to significant erosion. In many locations during the last 125 years, the average annual rate of loss has been from 1 to 5 feet (0.31-1.52-m). The only consistent shoreline damage information available for the Great Lakes is that compiled for the 1951-1952 record high-water period. The damage information collected under Corps of Engineers supervision pertained to the period from the spring of 1951 to the spring of 1952. During this period, the total damage to all shoreline properties was $61 million; wave action was responsible for $50 million and flooding accounted for the remaining $11 million.

2.62 The shoreline in the vicinity of Hammond Bay Harbor is characterized by a series of points and cusps. Early data indicate that light erosion and accretion has established a natural equalization of shoreline processes--material eroded from the points tends to fill-in the small bays. The present site of Hammond Bay Harbor lies between two points, Pond Point and Highway Point. Prior to harbor construction, these two points were indeed eroding with the bulk of the material collecting in the cusp just south of Pond Point.

2.63 Since 1963, when the Hammond Bay breakwaters were constructed, the shoreline along the embayment just north of the harbor has been observed to be moving rapidly. A sand spit has formed between the westerly breakwater and the shoreline. This spit is a part of a fillet formation which extends north tapering off rapidly. Beginning about 700 feet (213 m) from the breakwater, the shoreline has been observed to move rapidly landward since 1963. The area of particular concern is immediately adjacent to the fillet.

2.64 One structure can be seen in aerial photographs taken in 1961 standing on the shoreline about 1,000 feet (305 m) from where the west breakwater was to be constructed. The structure is no longer standing, having been lost to the advancing lake; the place where the structure stood is now under water. Two other residential structures located about 1,200 feet (366 m) north of the breakwater are now being threatened. The owners have constructed a wooden seawall and placed heavy cobbles against the lakeward face. Between 1963 and 1973 the shoreline moved landward about 120 feet (37 m) at the worst point. If this movement were to continue indefinitely, the shoreline will soon reach U.S. Highway 23, which now lies just over 100 feet (31 m) from the shore.

2.65 During the winter of 1964 water levels dropped to the lowest point in recent history. Between 1964 and 1973 the Lake rose to its highest level in 21 years. The total change in this period exceeded 5.5 feet (1.7 m). Such a rapid change is frequently sufficient to reverse or diminish the apparent magnitude of an accretional trend or make an erosional trend appear much more severe. One result of the combination of erosion and rising lake level has been the very rapid recession

of the shoreline. The fact that accretion has been clearly apparent in the fillet area despite the rise in lake level is indicative of its high rate of movement.

Influence of the Navigation Structures on the Shoreline

2.66 It is clear that the Hammond Bay Harbor navigation structures have caused changes in the adjacent northerly shoreline. This is evidenced by the rapid formation of a fillet and high rate of erosion which has occurred over the adjacent reach. Significant changes in drift potential caused by the presence of the harbor structures were found only in the small embayment between Highway Point and Pond Point. There is no clear effect of the harbor on the southerly shoreline beyond Highway Point.

2.67 Introduction of the harbor structures resulted in some substantial changes in the drift potential. The natural (without harbor) trend for the embayment was the net transport of littoral materials from the points into the bay, resulting in the formation of a pocket beach. Because of the sharp angle of the shoreline at Pond Point, transport potential exists only into the bay, making the probability of transport out of the north end of the bay very small. The angle of the shoreline at Highway Point allows potential transport out of the south end of the bay under certain wave conditions.

2.68 The configuration of the breakwaters eliminates any contribution of sediment from the south beyond Highway Point into the bay. Drift potential was predominantly away from Highway Point; any material which happens to reach the point

from the south no longer meets a drift potential into the bay and, hence, is eventually returned to the southerly beach or is lost offshore.

2.69 The effects of refraction naturally limit the wave exposure of the south flank of Pond Point. The location of the outer breakwater is not sufficiently lakeward to significantly modify the drift potential of the point. The effect increases rapidly from Pond Point south into the bay. Increasing amounts of the southerly wave energy are shadowed out. This results in a decline in the northerly drift potential until, in the extreme, only the southerly drift component remains. The gross drift (difference between drift in either direction) increases in its southerly potential. The reorientation of the shoreline accompanying fillet formation trends toward a condition where the shoreline is perpendicular to the direction of the predominant wave energy.

2.70 The incidence of waves from the northerly sectors on the breakwaters results in some amount of wave reflection which causes a portion of the incoming energy to strike the beach from an easterly direction. The magnitude of the reflected energy is a function of the permeability, cross-sectional shape and smoothness of the breakwater. The effect is to diminish the southerly drift potential during these periods. Because of the obvious fillet accumulation and improved beach stability north of some privately-constructed shore protective works, it is apparent that whatever energy is reflected is insufficient to overcome the southerly drift potential.

Air, Water, and Sediment Quality

2.71 Detailed air quality data are not available for the Hammond Bay vicinity. Presque Isle County is located in the Environmental Protection Agency's Region V, which is investigated by EPA's Air Surveillance Branch, and within Air Quality Control Region 126. This region is rated as priority III for suspended particulates, sulphur dioxide, carbon monoxide, and oxidants. Priority III is defined as an area having the lowest air pollutant levels for those standards set by EPA, denoting a relatively unpolluted condition of air quality.

2.72 Water quality in the main body of Lake Huron is excellent. Lake Huron waters are low in turbidity and moderate in hardness. Table 8 presents water quality data for surface and bottom waters for samples taken about 160 feet (50 m) off the mouth of Hammond Bay Refuge Harbor. Studies conducted by the Great Lakes Fishery Laboratory indicate the overall high quality of this area's water. The proposed project will impact localized water quality only by temporarily increasing turbidity conditions close to shore.

2.73 Physical and chemical properties of sediments in Hammond Bay Harbor were studied in June of 1970 by the Federal Water Quality Administration. Sediment sampling stations are shown in Figure 8; a description of bottom sediments is presented in Table 9. Sediments were primarily composed of dark-gray silt with an "earthy" odor. Some clay was also found, and usually constituted about 10% of the sampled volume. Stations HB 6 and 7 lie in the more exposed region of the mouth of the harbor and show an increased proportion of sand, pebbles, and gravel. No evidence of oil was observed at any of the seven sampled stations.

TABLE 8. WATER QUALITY OF SURFACE AND BOTTOM WATERS AT HAMMOND BAY REFUGE HARBOR[a]

CHEMICAL PARAMETER	DATE OF SAMPLE[b]								PHS DRINKING WATER STANDARDS
	25 April		10 July		6 August		7 November		
	S	B	S	B	S	B	S	B	
Nitrate (mg/l)	250	252	164	147	161	185	217	218	45
Ammonia (mg/l)	10	4	7	2	13	8	21	3	-
Total phosphorus (µg/l)	10	10	6	6	2	2	2	2	-
Silica (mg/l)	1.95	1.95	0.80	0.75	0.45	0.45	1.60	1.60	-
Chloride (mg/l)	5.2	5.2	6.0	6.4	6.0	6.0	5.3	5.3	250
Magnesium (mg/l)	7.0	7.0	7.5	7.7	8.0	8.0	7.5	7.5	-
Sodium (mg/l)	4.3	4.5	4.8	5.1	4.9	5.2	4.1	4.0	80
Potassium (mg/l)	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	-
pH	7.9	7.9	8.0	7.9	8.3	8.3	8.0	8.0	-
Alkalinity (mg $CaCO_3$/l)	90	90	88	92	98	98	90	98	-
Conductivity µmhos @ 25°C	220	220	230	230	253	255	222	218	-

[a]Samples taken near the mouth of the Hammond Bay Refuge Harbor.

[b]Sample dates are in year 1974.

S = data from surface waters.

B = data from bottom waters.

Source: Great Lakes Fishery Laboratory, Fish and Wildlife Service.

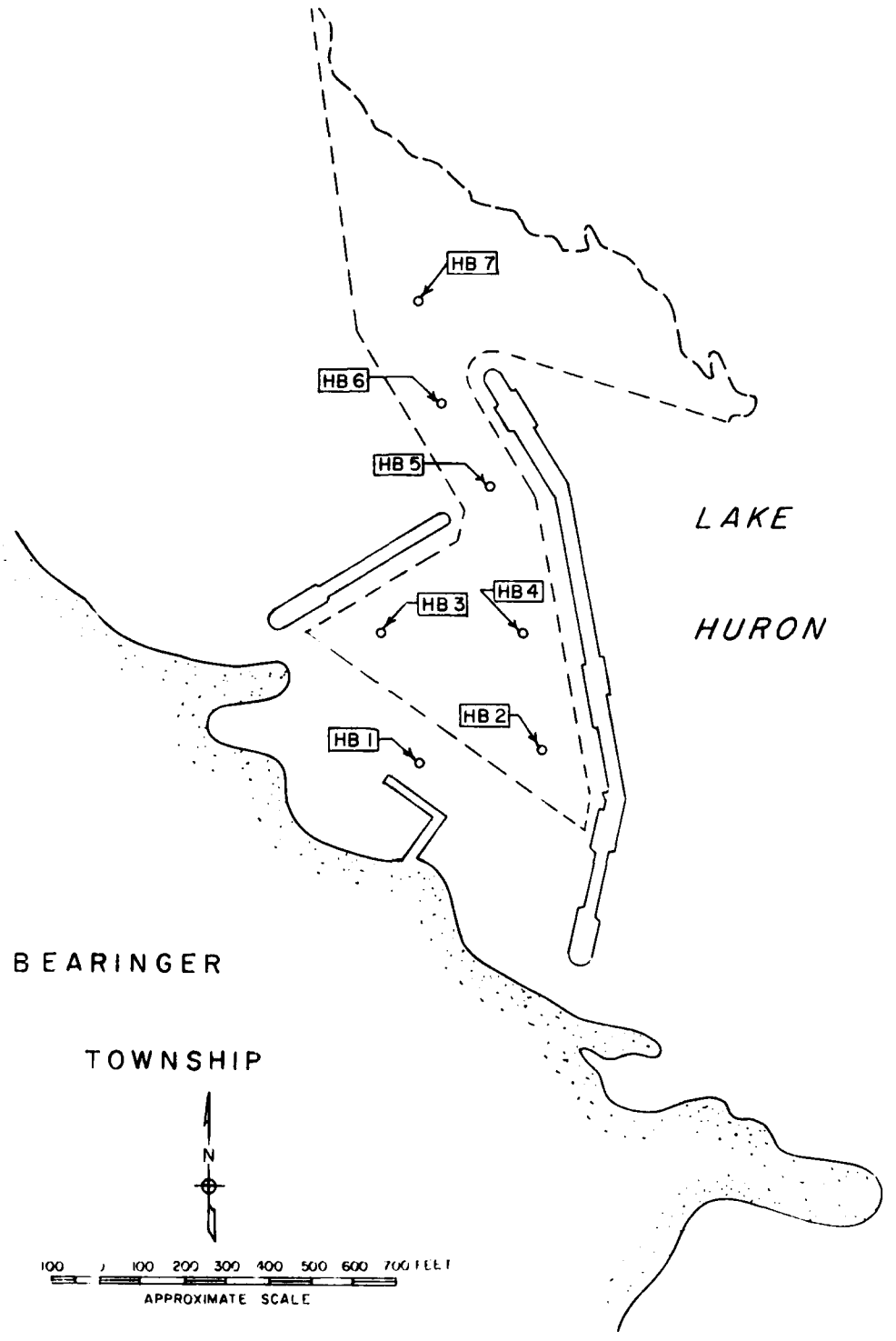


FIGURE 8. Sediment Sampling Stations, Hammond Bay Refuge Harbor

TABLE 9. BOTTOM SEDIMENT DESCRIPTION IN HAMMOND BAY REFUGE HARBOR (1970)[a]

STATION NUMBER[b]	SEDIMENT DESCRIPTION			
	Color	Odor	Oil	Percent Composition
HB-1	dark gray	earthy	none	silt-80, clay-10, ooze-5, sand-5
HB-2	gray	earthy	none	silt-90, clay-10
HB-3	dark gray	earthy	none	silt-80, clay-10, sand-10
HB-4	dark gray	earthy, musty	none	silt-65, clay-25, sand-10
HB-5	dark gray silt, brown ooze	earthy, fishy	none	silt-80, clay-10, ooze-10
HB-6	sandy	none	none	sand-34, clay-33, pebbles-33
HB-7	sandy	none	none	sand-90, gravel-8, marl-2

[a]Samples collected 30 June 1970.

[b]Refer to Figure 5 for Station Location.

Source: Federal Water Quality Administration, U.S. Department of Interior.

Flora

'.74 The State of Michigan lies within two forest belts: the)eciduous Forest and the Northeastern Conifer Forest. Mixtures ccur throughout the State, especially in the northern half of he lower peninsula. The principle deciduous area of the lower eninsula lies south of latitude 43°. This forest is dominated y the sugar maple and the beech, constituting about 60% of the orest cover. Some deciduous (hardwood) species extend north nto the so-called "pine" country along the shores of Lakes lichigan and Huron, such as the tulip tree, papaw, and the logwood. Nearly 90 tree species are indigenous to Michigan; ome are listed in Table 10.

'.75 The northern half of the lower peninsula is morainal in haracter, with diverse conditions of topography, soil, and egetation. The dominant tree growth is coniferous with ccasicnal tracts of hardwoods, especially on the heavier orainic soils. Gray pine (or Jack pine) occur within the nterior, as do white pine and red pine. Occasionally, there re dense stands of hemlock where the land is hilly and moist.

'.76 Shoreline flora species are generally found just beyond he beach where the sand is not subject to wave action. On pen, sandy ground only a few plant species can be observed, uch as the sea-rocket, seaside spurge, and an occasional each pea. Just landward of the beach, several plant species ave stabilized the moving sand, including: beach grass, reed rass, and the little bluestem. A partial list of plant species ecorded for the northern half of Michigan's lower peninsula is resented in Table II. In the transitional zone between this egetational band dominated by grasses and the conifer zone

TABLE 10. SELECTED INDIGENOUS TREE SPECIES OF MICHIGAN

SCIENTIFIC NAME	COMMON NAME
Juniperus virginiana	red cedar
Juniperus communis	common juniper
Platanus occidentalis	sycamore
Nyssa sylvatica	tupelo
Prunus serotina	wild black cherry
Sassafras albidum	sassafras
Ulmus fulva	slippery elm
Carpinus caroliniana	horn beam
Ostrya virginiana	ironwood
Acer rubrum	red maple
Acer saccharum	sugar maple
Fagus grandifolia	beech
Fraxinus sp.	ash
Pinus banksiana	jack pine
Pinus strobus	white pine
Quercus rubra	red oak
Quercus velutina	black oak
Tilia americana	basswood
Tsuga canadensis	hemlock
Picea mariana	black spruce
Salix nigra	black willow
Larix laricina	tamarack
Thuja occidentalis	balsam fir
Ulmus americana	American elm
Acer saccharinum	silver maple
Liriodendron tulipifera	tulip tree
Asimina triloba	papaw
Cornus florida	dogwood
Cornus stolonifera	red-osier dogwood
Populus deltoides	cottonwood

Source: Darlington, Michigan Technical Bulletin, #201.

TABLE 11. SELECTED PLANT SPECIES RECORDED IN THE NORTHERN HALF OF MICHIGAN'S LOWER PENINSULA[a]

SCIENTIFIC NAME	COMMON NAME
Iris lacustris	dwarf lake iris[b]
Cirsium pitcheri	Pitcher's thistle
Solidago houghtonii	Houghton's goldenrod
Tanacetum huronense	Lake Huron tansy
Ammophila breviligulata	beach grass
Lathyrus maritimus	beach pea
Cakile edentula	sea-rocket
Euphorbia polygonifolia	seaside spurge
Bromus pumpellianus	Pumpelly's bromegrass
Corispermum hyssopifolium	bugseed
Orobanche fasciculata	broom-rape
Anemone multifada	red windflower
Hypericum Kalmianum	Kalm's St. Johnswort
Salix cordata	sand dune willow
Salix glaucophylloides	dune willow
Juniperus horizontalis	prostrate juniper
Hudsonia tomentosa	beach-heath
Satureja arkansana	calamint
Myrica gale	sweet gale
Cephalanthus occidentalis	buttonbush
Chamaedaphne calyculata	leather leaf
Ledum groenlandicum	Labrador tea
Calamovilfa longifolia	reed grass
Andropogon scoparius	little bluestem
Prunus pumila	sand cherry
Artemisia caudata	tall wormwood
Solidago hispida	hairy goldenrod
Potentilla anserina	silver-weed
Andromeda glaucophylla	bog rosemary
Kalmia polifolia	pale laurel

[a] North of Saginaw.

[b] Threatened Status in Michigan.

Source: Guire and Voss, 1963.

beyond, one finds a few shrubs such as the sand dune willow, sand cherry, red-osier dogwood and an occasional cottonwood tree.

2.72 The terrestrial region contiguous to the beach consists of forested areas composed predominantly of those trees listed in Table 10 and a variety of plants such as beach grass and blueberries. Red cedar swamps, willow thickets, and pine groves lead from the beach to inland areas. These are frequently interspersed with occasional meadows of wild flowers, which are bordered by alder and birch groves. Undeveloped lands are forested with scrub oak, pine, some mixed hardwoods, and alder groves. The immediate project area is relatively open and affords little food and cover for wildlife.

2.73 Phytoplankton accounts for the bulk of the productivity in Lake Huron waters. Planktonic organisms, which characteristically show seasonal changes in abundance and species diversity, are most populous in the inshore waters. Diatoms have a temperature-dependent spring/summer reproductive bloom in inshore and offshore lake waters, whereas green and blue-green algal populations peak from summer to fall. Important control factors governing the concentrations and distribution of these forms include lake winds, currents, light intensity, nutrients (especially phosphorous), turbidity, grazing, and fungal parasitism. Lake phytoplankton biomass consists of flagellates, blue-green, and green algae.

Fauna

2.81 Open lake zooplankton are dominated by copepods in terms of absolute numbers and species diversity. Flagellates, ciliates, rotifers, and cladocerans are also important components of this system. Zooplankton feed upon the phytoplankton and are in turn eaten by certain fish. Generation times of most zooplankton are relatively short, requiring from a week to two months. Zooplankton and phytoplankton may be transported in discrete water masses and usually exhibit clumped distribution patterns in nearshore waters.

2.82 Among the dominant groups of the bottom-dwelling fauna are the amphipods, tubificid worms (sludge worms), aquatic insects (chironomids), leeches (Hirudinea), and hydra (coelenterates). Benthic community distribution in the lake varies substantially with sediment type, stability, and water depth. There also appears to be a "concentration zone" in water from 115-160 feet (35-49 m) deep, in which benthic oligochaete species are particularly sensitive to environmental quality. Chironomids and Tubificidae dominate the benthos in water depths less than 20 feet (6.2 m); amphipods and oligochaetes predominate in deeper water sediments where sands are finer and have greater organic and bacterial content. Few burrowing forms inhabit the inshore zones where wave-induced

sediments are very unstable. Overall, Lake population abundances fluctuate seasonally.

2.82 Since 1879 there have been substantial changes in Lake Huron's fish populations. Several native species (i.e., whitefish, trout, and herring) populations declined from 1952 to 1956 due to increased commercial fishing and invasions of the lamprey and alewife. There are approximately 170 fish species in the Great Lakes drainage system. Representative important species in the vicinity of Hammond Bay Harbor are presented in Table 12. Nine species are identified as having threatened or endangered status in northern Lake Huron.

2.83 Most fish species regularly consume benthic organisms, such as worms, insect larvae, crustaceans, and molluscs. However, some fish, such as salmon, are primarily piscivorous throughout most of their life cycles. Inshore regions of western Lake Huron having sand-gravel bottoms, rocky shoals, or extensive growths of large aquatic plants are potential spawning grounds for several fish species. Families represented by such species include sucker (Catostomidae), sculpin (Cottidae), stickleback (Gasterosteidae), smelt (Osmeridae), perch (Percidae), trout perch (Percopsidae), and herring (Clupeidae). In order to avoid adverse impacts to these fish and associated fishery activities, implementation of the proposed construction will be scheduled between late June and mid-September, as recommended by the Fisheries Division of the Department of Natural Resources.

TABLE 17. FISH SPECIES RECORDED IN THE VICINITY OF HAMMOND BAY HARBOR (From "Representative Important Species," Michigan Water Resources Commission, July 25, 1974)*

SCIENTIFIC NAME	COMMON NAME	STATUS
Acipenser fulvescens	Lake sturgeon	TE
Catostomus commersonii	White sucker	C
Catostomus catostomus	Longnose sucker	C
Alosa pseudoharengus	Alewife	C
Coregonus artedi	Lake herring	TE
Coregonus hoyi	Shortnose cisco	TE
Coregonus zenithicus	Shortjaw cisco	TE
Coregonus kiyi	Kiyi cisco	TE
Coregonus clupeaformis	Lake whitefish	C
Coregonus hoyi	Bloater	TE
Cottus cognatus	Slimy sculpin	C
Cottus bairdi	Mottled sculpin	C
Cyprinus carpio	Carp	C
Notropis hudsonius	Spottail shiner	C
Notropis atherinoides	Emerald shiner	TE
Lota lota	Burbot	C
Pungitius pungitius	Ninespine stickleback	C
Osmerus mordax	Rainbow smelt	C
Perca flavescens	Yellow perch	C
Percina caprodes	Log perch	TE
Percopsis omiscomaycus	Trout perch	C
Salvelinus namaycush	Lake trout	C
Salmo gairdneri	Rainbow trout	C
Salmo trutta fario	Brown trout	C
Oncorhynchus kisutch	Coho salmon	C
Oncorhynchus tshawytscha	Chinook salmon	C
Micropterus dolomieui	Smallmouth bass	C
Coregonus alpenae	Longjaw cisco	TE
Prosopium cylindraceum	Round whitefish	C
Esox lucius	Northern pike	C
Stizostedion vitreum	Walleye	C

C = Common

TE= Threatened or endangered

*At the request of the U.S. Department of Interior and Michigan's Department of Natural Resources, this listing excludes mention of Atlantic salmon (*Salmo salar*), sunset (*Oncorhynchus nerka*), and brook trout (*Salvelinus fontinalis*).

2.84 Coho salmon were introduced to Lakes Huron and Michigan to help control the alewife and to provide a game fish. The amount of stream spawning is very limited; consequently, maximum lake populations depend on hatchery plantings. As the ice breaks up in late March, open-water coho activity begins in southern Lakes Michigan and Huron. Coho remains in shallow waters as long as water temperatures remain in the mid 50's (Fahrenheit); they avoid rapid temperature changes and are likely found at depths of 200 feet (61 m) or more. As surface waters warm above 60° F, coho move offshore into deeper waters; by July, they are usually several miles (km) offshore.

2.85 Chinook salmon also appear in offshore waters about mid-July through September. Chinook may be found in open water in spring and early summer, migrating to parent streams by late July. In early September they move upstream to spawn. This species prefers 50-55°F and are similar to coho salmon in habits and preferences.

2.86 Rainbow trout were introduced to the Lake Huron and Michigan area in 1876, and were subject to population declines from the lamprey and overfishing. Recent lamprey controls and fishing restrictions have allowed a population rebound. Rainbow trout are anadromous; a stream-born rainbow (1-2 years old), having reached one of the Great Lakes, takes on a silvery look and is then called a steelhead. Steelhead usually orient themselves in shoal areas swept by currents. These fish are primarily spring spawners, running upstream to spawn during April through early May. Some fish do make fall runs in September and October. In late spring and summer steelhead can normally be found in open waters within a mile (1.6 km) of shore at depths of less than 50 feet (15 m).

2.87 The temperature-sensitive alewife is currently the dominant fish species in Lake Huron. High populations, relative absence of predators, and effectiveness as a filter feeder has given the alewife a competitive advantage over certain native and introduced species (herring, shiners, smelt, ciyi, and bloaters). Consequently, the alewife has been responsible for major changes in the Lake's foodchain, and is the overall principal forage fish for major Lake predators.

2.88 The birds of the Hammond Bay area comprise two groups--those which are permanent residents (Table 13) and those which migrate and/or form temporary breeding colonies in the area (Table 14). A total of 95 of the more common representative species which are associated with shoreline and marshland regions around Hammond Bay are listed in these tables.

2.89 Birds common to the area can be grouped into categories determined by their habitats. Birds which feed primarily along the shoreline are the sandpipers, killdeer, and plovers--normally found during the summer months. Birds associated with open bodies of water are mostly diving ducks, such as grebes, mergansers, scaups, golden-eye and buffle-heads. These diving ducks normally frequent the Great Lakes through the winter months, often grouping in open water near the harbor areas. Several species of gulls and terns also occupy this area.

2.90 A total of 35 species of mammals [illegible] recorded in Table 15 and represent those in the Hammond Bay area. Some of these animals may no longer be found in the vicinity.

TABLE 13. LIST OF BIRDS THAT STAY THE YEAR ROUND IN THE NORTHERN MICHIGAN AREA

SCIENTIFIC NAME	COMMON NAME
Colinus virgianus	Bob-White quail
Bonasa umbellus	Ruffed grouse
Phasianus colchicus	Ring-necked pheasant
Philohela minor	Woodcock
Larus argentatus	Herring gulls
Larus delawarensis	Ring-billed gulls
Sfrix varia	Barred owl
Bubo virginianus	Great horned owl
Otus asio	Screech owl
Cryptoglaux acadia	Saw-whet owl
Melanerpes erythrocephalus	Red-headed woodpecker
Dryobates pubescens	Downy woodpecker
Dryobates villosus	Hairy woodpecker
Cyanocitta cristata	Blue jay
Corvus brachyrhychus	Crow
Penthestes atricapillus	Black-capped chickadee
Baeolophus	Tuft titmouse
Sitta carolinensis	White breasted nuthatch
Sitta canadensis	Red breasted nuthatch
Certhia familiaris	Brown creeper
Nannus hiemalis	Winter wren
Regulus satrapus	Golden crown kinglet
Bombycilla cedrorum	Cedar waxwing
Lanius borealis	Northern shrike
Sturnus vulgaris	Starling
Passer domesticus	Mouse sparrow
Zamelodia ludoviciana	Rose breasted grossbeak
Hesperiphona vespertina	Evening grossbeak
Carpodacus purpureus	Purple finch
Spinus	Gold finch
Acanthis linaria	Common redpoll
Spinus pinus	Pine siskin
Junco hyemalis	Slate-colored junco

Source: A.O.U., 1957.

TABLE 14. LIST OF BIRDS THAT ARE SEASONAL RESIDENTS OF THE NORTHERN MIGHICAN AREA (Nesting or Migratory)

SCIENTIFIC NAME	COMMON NAME
Phloeotomus pileatus	Pileated woodpecker
Tyrannus tyrannus	Eastern kingbird
Myrarchas crinitus	Crested flycatcher
Petrohelidon	Bank swallows
Progue sabis	Purple martins
Troglodytes aedon	House wren
Dumetolla caroliensis	Catbird
Toxosterna rufern	Brown thrasher
Planesticas migratorius	Robin
Hylocichla migratorius	Wood thrush
Hylocichla guttata	Hermit thrush
Hylocichla alicia	Gray checked thrush
Hylocichla fuscescens	Veery
Sialia sialia	Bluebird
Mniotilta varia	Black and white warbler
Dendroica caerulescens	Black throated warbler
Dendroica aestiva	Yellow warbler
Dendroica fusca	Black burnian warbler
Seiurus aurocapillas	Oven bird
Sturnella magna	Meadowlark
Agelaius phoeniceus	Red wing blackbird
Icterus spurius	Orchard oriole
Icterus galbula	Baltimore oriole
Euphagus quiscephalus	Brewer's blackbird
Molothrus ater	Brownheaded cowbird
Quiscalus quiscula	Grackle
Piranga erythromelas	Scarlet tanager
Passerina cyanea	Indigo bunting
Spizella monticola	Tree sparrow
Spizella pusserina	Chipping sparrow
Zonotrichia albicollis	White crowned sparrow
Zonotrichia separata	White throated sparrow
Passerella iliaca	Fox sparrow
Plectrophenax nivalis	Snow bunting
Sterna hirundo	Common tern
Coccyzus erythrophthalmus	Yellow billed cuckoo
Coccyzus erythrophthalmus	Black billed cuckoo

Continued Next Page

TABLE 14 (Cont'd.) LIST OF BIRDS THAT ARE SEASONAL RESIDENTS OF THE NORTHERN MICHIGAN AREA (Nesting or Migratory)

SCIENTIFIC NAME	COMMON NAME
Nyctea nyctea	Showy owl
Antrostomus vociferas	Whip-poor-will
Chordeiles virginianus	Common nighthawk
Archilochus colubris	Ruby-throated humming bird
Cerylaelycon	Belted kingfisher
Coloptes auratus	Yellow shafted flicker
Aix sponsa	Wood duck
Marila collaris	Ring-necked duck
Marila americanus	Redhead
Marila valisineria	Canvas-neck
Ardea herodias	Great blue heron
Herodias egretta	American eggret
Chen hyperboreus	Snow goose
Chen caerulescens	Blue goose
Branta canadensis	Canada goose
Olor columbianus	Whistling swan
Ixobrychus exilus	Least bittern
Botaurus lentiginosus	American bittern
Nycticorax nycticorax	Black-crowned night heron
Anas platyrhinchos	Mallard
Anas rubripes	Black duck
Chaulelasmus streperus	Gladwall
Mareca americana	Baldpate
Dafila acuta	Pintail
Spatula clypeata	Shoveler

Source: A.O.U., 1957.

TABLE 15. MAMMALS OF THE HAMMOND BAY AREA
(Some may no longer be found in the area)

SCIENTIFIC NAME	COMMON NAME	STATUS
Condylura cristatus	Star-nosed mole	UC
Sorex cinereus	Masked shrew	C
Blarina brevicanda	Short-tailed shrew	C
Castor canadensis	Beaver	TE
Lepus americanus	Snowshoe rabbit	C
Tamias striatus	Eastern chipmunk	C
Marmota monax	Woodchuck	C
Spermophilus tridecemlineatus	Thirteen-lined ground squirrel	C
Peromyscus leucopus	White-footed mouse	C
Microtus pennsylvanicus	Meadow vole	C
Ondatra zibethicus	Muskrat	C
Mus musculus	House mouse	C
Zapus hudsonius	Meadow jumping mouse	C
Erethizon dorsatum	Procupine	TE
Urocyon cinereoargenteus	Gray fox	C
Ursus americanus	Black bear	TE
Procyon lotor	Raccoon	C
Mustela frenata	Long-tailed weasel	P
Mustela vison	Mink	P
Taxidea taxus	North American Badger	C
Lutra canadensis	River otter	UC
Mephitis mephitis	Striped skunk	C
Lynx rufus	Bobcat	UC
Odocoileus virginianus	White-tailed deer	C
Sylvilagus floridanus	Eastern cottontail rabbit	C
Glaucomys sabrinus	Northern flying squirrel	UC
Tamiasciurus hudsonicus	Red squirrel	C
Sciurus carolinensis	Gray squirrel	C
Glaucomys volans	Southern flying squirrel	C
Pitymys pinetorum	Pine vole	TE
Clethrionomys gapperi	Red-backed vole	C
Napeozapus insignis	Woodland jumping mouse	UC
Canis latrans	Coyote	TE
Mustela nivalis	Least weasel	C
Mustela erminea	Ermine	P

C = Common
UC= Uncommon
P = Protected
TE = Threatened or Endangered Species

Source: Long, 1974.

Recreation

2.91 Of Michigan's 36.5 million acres (14.8 million ha), 19 million acres (7.7 million ha), or 52% are classified as forest land. The Forestry Division of Michigan's Department of Natural Resources administers nearly 3.8 million acres (1.7 million ha) of state forests, while the U.S. Forest Service administers about 2.6 million acres (1.6 million ha) of national forests.

2.92 Northeast Michigan offers the sport fisherman an abundance of opportunities. Lake and river fishing is excellent with brown, lake, and rainbow trout; large- and small-mouth bass, pike, coho; and perch being most prominent. Lake trout, native to the Great Lakes, are most commonly taken in spring and fall. Inland lakes, rivers, and streams support a variety of species, including yellow perch, northern pike, and walleye. Chinook salmon have also entered into Lake Huron sport fisheries. Sport fishing off the breakwaters in Hammond Bay Harbor is popular with both local and seasonal fishing enthusiasts. Additionally, a boat launching ramp is located in the harbor for use by the public. Until the early 1940's, the sport fishery was stimulated by lake trout abundance. Fisheries have suffered the effects of overfishing, alewife competition and lamprey predation. Restorative programs began in the 1950's with the application of selective poisons in lamprey spawning streams and the plantings of lake trout and other predator species (coho and chinook salmon, and steelhead trout in 1967; and lake trout in the

early 70's). Approximately 14 million trout and salmon were stocked in the Great Lakes and inland Michigan waters in 1971.

2.93 Northeast Michigan is famous for hunting and [illegible]. Hunting for white-tailed deer and small game species, [illegible] snowshoe hare, cottontail rabbits, and tree squirrels [illegible] many people to the area. Good habitat conditions provide the small game hunter with some of the best ruffed grouse and woodcock hunting in the State.

THREATENED OR ENDANGERED SPECIES

2.94 The Report on Endangered and Threatened Plant Species of the United States (Federal Register, June 16, 1976) has been consulted. There are no known species of rare, endangered or threatened plant that will be affected by the proposed project. The National Registry of Endangered and Threatened Wildlife and Plants (Federal Register, October 27, 1976) was consulted for species of fish and wildlife. Nine fish species are identified as having threatened or endangered status in northern Lake Huron as listed in Table 12. Five animal species are listed as threatened or endangered, three have a protected status in Michigan, and five are designated as uncommon. The proposed project will not affect these or other rare, threatened, or endangered species of fish or wildlife.

3. RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS

3.01 The United States shorelands of Lake Huron are located entirely within the State of Michigan and have a total mainland length of about 634 miles (1,021 km). Some of the communities from Cheboygan County south to Arenac County include Mackinaw City, Cheboygan, Rogers City, Alpena, Harrisville, and Tawas City.

3.02 Use and development of this shore is for seasonal and permanent residential housing, some agricultural use, and forest lands, particularly in the northerly areas.

3.03 Shoreline development in this region was examined in The Great Lakes Regional Inventory Report - National Shoreline Study, which includes the Hammond Bay vicinity. The area of study extends from the Straits of Mackinac to the southern border of Arenac County, encompassing the shoreline Counties of Cheboygan, Presque Isle, Alpena, Alcona, Iosco, and Arenac. Table 16 represents the land use data resulting from this study for the coastal subarea; land uses have been divided into major categories for evaluation and clarity.

3.04 Overall, residential lands constitute nearly 40% of the total coastal subarea. Industrial and commercial uses take up only 3.7%, and agricultural and undeveloped lands account for 11%. Public buildings and related lands occupy only 0.8% of the studied shoreline. Parks comprise 7.2%, and forest areas make up the remaining 37.4%. There are 5 commercial harbors, 12 recreational boat harbors, and one electric power site along this stretch of coastline.

TABLE 16. LAND USE DATA FOR LAKE HURON SHORELINE - CHEBOYGAN COUNTY TO ARENAC COUNTY, MICHIGAN

LAND USE CATEGORY	MILES	KM	PERCENT OF TOTAL	PUBLIC			PRIVATE LAND	
				NON-FEDERAL		FEDERAL		
				Miles	km		Miles	km
Residential	105.0	168.0	39.9	-	-	-	105.0	168.0
Industrial and Commercial	9.7	15.5	3.7	-	-	-	9.7	15.5
Agricultural and Undevloped	29.0	46.4	11.0	-	-	-	29.0	46.4
Public Buildings & Related Land	2.2	3.5	0.8	2.2	3.5	-	-	-
Parks	18.9	30.2	7.2	18.9	30.2	-	-	-
Forest	98.5	157.6	37.4	3.2	5.1	-	95.3	152.5
TOTAL	263.3	421.2	100.0	24.3	38.8	-	239.0	382.4

Source: National Shoreline Study Regional Inventory Report, 1971

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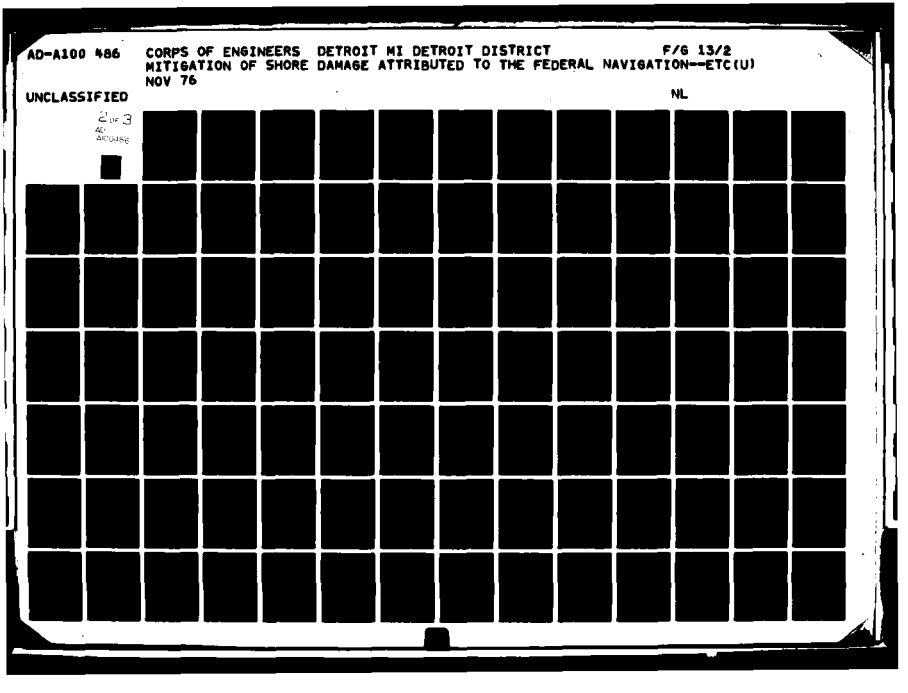


3.05 Table 16 also shows a total of 24.3 miles (38.8 km) of public, non-federal shoreland in the study area, 239 miles (382.4 km) of private land, and no federally-owned lands along the shoreline of this subarea. There are no national parks or recreation areas among the Lake Huron shorelands. Extensive recreational use is provided by both state and national forest lands, although these areas are not managed exclusively for recreational purposes.

Land Use Within the Zone of Harbor Influence

3.06 Development of the Hammond Bay Harbor area was very sparse prior to 1938 when the highway was constructed. Most of the land near the harbor is still undeveloped. The parcels that are currently held by individual private owners lie just north of the harbor on either side of the highway and along the shoreline. These parcels were platted prior to 1961, perhaps in anticipation of harbor development.

3.07 The State of Michigan owns the land at Highway Point, which is adjacent to the harbor. Here, the Michigan State Highway Department maintains a roadside park with picnic facilities. The land for many miles inland from the harbor is heavily timbered and is owned by the Abitibi Corporation, a manufacturer of lumber products. Little or no development has taken place nor is any expected in those areas in the near future.

3.08 Based on estimates by local realtors, county equalization officials, and various private citizens, land values of lakefront property range from a low of about $100.00 to a high of about $125.00 per front foot for lots suitable for

building. Assuming a minimum usable lot depth of about 200 feet (61 m), the value per square foot is about $0.50. The usable depth is what is left after deducting beach and unstable bluff areas.

3.09 As the lakefront erodes, some lots eventually become unbuildable because of insufficient depth. Property in that case declines rapidly to the point where it is basically worthless. In most cases, structures situated in areas of high erosion are either allowed to depreciate as the time of eventual loss nears or maintained until it becomes necessary to move the structure. The cost of moving an average single-family dwelling is estimated to be about $10,000.

Relationship of the Proposed Action to Land Use Plans

3.10 Much of the shoreland that would benefit under the proposed plan has already been platted, and a few residential structures occupy the developed lands. The State of Michigan, under the Shoreland Protection and Management Act, has no control over shoreland already platted and developed. Its effects would not eliminate unwise development in developed areas subject to erosion.

3.11 The Corps proposes to mitigate erosion damage attributable to the Federal navigation structures at Hammond Bay Harbor. In doing so, existing lands will be stabilized and the present condition of erosion, which is interfering with the residential use of the shoreland, would be alleviated. The result of this effort would be the ultimate protection of existing and anticipated residential development along the Lake Huron shore

north of Hammond Bay Harbor to Pond Point. Thus, mitigation of erosion damage using an artificially-filled groin would enhance and encourage the current local land use for the area affected.

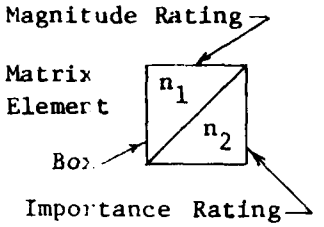
3.12 The U.S. Fish and Wildlife Service operates the Hammond Bay Biological Station along the shores of Lake Michigan, 10 kilometers south of the Refuge Harbor. This station is included in the national registry of ecologically worthy sites. Because of its unique location, isolated from effects of human development it has served as an experimental ecological reserve study site. It will not be impacted by this project or any presently proposed land use development occuring as a result of the Harbor of Refuge.

4. ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

4.01 The effect (impact) of the proposed action on the existing environment has been thoroughly analyzed. In this section both beneficial and detrimental environmental changes that may result with implementation of an artificially-filled groin are discussed. A qualitative and, where possible, quantitative approach is used to identify the direct and indirect effects along with various intangible factors.

4.02 For this statement, evaluation of the environmental impact of the proposed action is accomplished with the aid of an impact matrix as shown in Table 17. This matrix was constructed in a manner enabling the impact of specific aspects of the action on certain environmental factors to be rated. As noted, there are 3 particular aspects of the action which will have some impact on one or more of 23 identifiable environmental factors: construction of the groin, construction of the beach-fill area, and the resulting modification of the shoreline. Each impact is quantifiably defined in terms of a set of two numbers placed in the appropriate matrix box element coinciding with the action aspect and the impacted environmental factor. The two numbers are separated by a diagonal line. The upper left-hand number defines the magnitude (i.e., degree, extensiveness, scale, probability of occurrence) of the impact upon that particular sector of the environment. The lower right-hand number weights the importance (i.e., significance) of the impact as it relates to the specifics of the action and of the existing environment as a whole. Both numerical ratings are on a scale of 1 to 10 in accordance with the following word weights:

LEGEND:



IMPACTED ENVIRONMENTAL FACTORS	Construction of Rock Groin	Construction of Beach Fill Area	Modification of the Shoreline	Positive (+)	Negative (-)	TOTALS
	ACTION ASPECTS CAUSING IMPACT			IMPACTS/FACTORS		
Shoreline Stability			6/6	1		1
Accretion		3/1	3/3	2		2
Erosion		5/5	6/6	2		2
Benthic Habitat	-1/-1	-5/-2	2/1	1	2	3
Benthic Organisms	-1/-1	-5/-2	1/1	1	2	3
Water Turbidity	-2/-1	-1/-1			2	2
Water Quality	-1/-1	-1/-1			2	2
Plankton	-1/-1	-1/-1			2	2
Aquatic Plants	-1/-1	-1/-1			2	2
Fishes	-1/-1	-1/-1			2	2
Terrestrial Vegetation	-4/-2	-3/-2	4/2	1	2	3
Birds	-2/-2	-2/-2			2	2
Health/Safety	-1/-1	-1/-1	3/6	1	2	3
Air Quality	-2/-1	-2/-1			2	2
Noise	-4/-2	-5/-2			2	2
Shoreline Serenity	-4/-1	-4/-1			2	2
Aesthetics	-4/-1	-4/-1	1/1	1	2	3
Recreation	-4/-1	-4/-1	4/2	1	2	3
Desirable Community Growth			4/5	1		1
Land Use			4/5	1		1
Employment	1/1	1/1		2		2
Property Values			4/3	1		1
Structures	-1/-1	-1/-1	4/6	1	2	3
IMPACTS/ACTION — Positive (+)	1	3	13	17[a]		
IMPACTS/ACTION — Negative (-)	16	16	0		32[b]	
IMPACTS/ACTION — TOTALS	17	19	13			49[c]

[a] Represents the total number of potential positive (+) impacts, i.e., the number of filled element boxes without minus signs.

[b] Represents the total number of potential negative (-) impacts, i.e., the number of filled element boxes with minus signs.

[c] Represents the total number of potential impacts, i.e., the number of filled element boxes.

Rating Numbers	Magnitude or Importance
1	Insignificant
2	Minimal
3	Minor
4	Discernible
5	Moderate
6	Significant
7	Substantial
8	Great
9	Major
10	Extreme

A minus (-) sign preceding a rating indicates that the impact is negative or adverse. If no minus sign is assigned, then the corresponding impact is positive (i.e., a plus sign is implied). Only those matrix box elements containing a diagonal line and two numbers represent an impacting situation. Box elements which are blank or empty represent no impact.

4.03 To illustrate the difference between a magnitude rating and an importance rating, the following examples are given:

Example 1: A particular action may reduce substantial erosion and be given a magnitude rating of 7; however, if erosion is quite common in the area, then the alleviated erosion (due to the action) is probably insignificant in terms of the normal total and could be given an importance rating of 1.

Example 2: A proposed groin might be of such design as to have little or no effect on the

normal passage of littoral drift. Hence, the possible occurrence of neighboring accretion and erosion problems (as a result of the structure) would be insignificantly remote, i.e., magnitude 1. If, however, the design were to fail for some unknown reason, the resulting effect might be major, i.e., its importance might be 9.

4.04 In addition to the 23 environmental factors presented in Table 17, other factors were considered during the evaluation of action-caused impacts, as required by Section 122, P.L. 91-611. Careful assessment of these environmental factors in light of the proposed action concludes that they will not be affected. Such factors include: commercial and industrial uses, desirable regional growth, community cohesion, displacement of farms, public services and facilities, civil works, displacement of people, and archaeological and historical resources.

4.05 Due to the relatively remote character of the construction site, environmental factors such as commercial and industrial uses, public services and facilities, and civil works will not be affected. Desirable regional growth and community cohesion will not be noticeably impacted due to the fact that very few people live on the affected shoreline, or even within Bearinger Township (67 people in 1970). Farms and local residents will not be displaced by the project, since construction is proposed for the immediate harbor area. The State Historic Preservation Officer and the State Archaeologist have been contacted and concur that, based on a preliminary assessment, no impacts to archaeological or historical resources will result from the proposed project.

4.06 With respect to the proposed plan, the impact matrix displays 49 potential impacts (most of which are adverse) as well as the magnitude and importance ratings of each. As noted, no rating is larger than significant (6). Environmental factors impacted to the largest degree are shoreline stability, erosion, health/safety and structures. The pattern of minus values and plus values indicate that all negative impacts are associa ed with the two, short-term construction aspects; the majority of positive impacts will result over the long-term associated with modification of the shoreline. Essentially, the short-term negative impacts associated with construction are necessary in order to bring about the long-term benefits of shoreline stability and mitigation of harbor-induced erosion.

Construction of a Rock Groin

4.07 This action aspect involves the short-term construction activities associated with placing a 150-foot (46-m) long rock groin approximately 700 feet (214 m) north of the harbor structures. The groin would extend lakeward in a direction perpendicular to the bluff line to a maximum water depth of about 3 feet (0.9 m) below Lower Water Datum. It is expected that the groin will be of rubble-mound construction using imported rock as armoring, and be less than 20 feet (6.1 m) wide at its base. Construction will require a 100-foot (31-m) long, 12-foot (3.7-m) wide access road for trucks to deliver groin material. A small, 12-foot (3.7-m) wide cut in the existing bluff will be required to provide access to the beach area. Groin construction will require either a shore-based crane, an access road on top of the groin, or a rock conveyor that will aid in placing the armor rock covering the groin.

In addition, approximately 40 truck-loads [delivering about 300 cu yds (230 cu m)] of groin material will be needed to build the structure. A total number of about 4 construction workers (a driver, equipment operator, foreman, and a supervisor) would require about seven working days to complete construction of the groin.

4.08 The short-term action of groin construction will not impact the long-term environmental factors of shoreline stability, accretion, and erosion. Instead, the overall effect of a groin where none previously existed is the modification of the shoreline, which has long-term effects on these factors. Such impacts are discussed later in this section.

4.09 Construction of a groin involves the placement of large rocks in the littoral zone. The benthic habitat is predominantly cobble and gravel at the proposed site for groin construction. Approximately 3,000 square feet (280 sq m) of benthic habitat will be smothered and destroyed during groin construction, and benthic organisms associated with this habitat would likely perish as the rocks are placed. However, this represents a very small portion of the large scale benthic environment, and the adverse impact is expected to be insignificant.

4.10 As groin construction materials are introduced into the nearshore waters, a certain amount of turbidity will result. Such turbidity will be temporary and occur mostly near the shore, where effects of waves and turbidity are common; impacts will be of minimal magnitude and insignificant importance. Water quality will be negatively impacted on a temporary basis by the increase of suspended solids during groin construction. Oil and fuel spills are expected to occur in insignificant amounts during groin construction. The general good quality of area waters indicate that such spills will be of insignificant importance.

4.11 As turbidity is increased and water quality is decreased, secondary impacts would result to plankton, aquatic plants, and fishes. Due to the brief and temporary nature of expected turbidity, these impacts will be insignificant. Numerous other aquatic regions are available for utilization by plankton, plants, and fishes; therefore, the importance values of these impacts are also insignificant. Since the project will necessitate construction in nearshore waters, a potential impact to fish in the area will result. As a mitigation measure identified in Section 1, construction will take place after late June and prior to mid-September, and will avoid further impacts to fish and fishery activities.

4.12 Groin construction materials will be delivered by trucks arriving from an inland quarry site. Approximately 300 cubic yards (230 cu m) of material is expected to be needed for groin construction. Since the average truck can carry about 8 cubic yards (6.1 cu m) per load, about 40 truckloads $\left(\frac{300}{8} = 37.5\right)$ of groin materials would be required. The trucks hauling these materials as well as those used to deliver (and ultimately remove) the groin construction equipment would enter or exit the area via U.S. Route 23. This additional traffic and its attending wear and tear to the roadway structure can be expected to result in a very slight increase in highway maintenance requirements, the magnitude of which would be insignificant compared to the normal. Moreover, consideration of this impact is of insignificant importance from the stand point of negligible cost to the Michigan taxpayer. A 100-ft (30-m) long by 12-ft (3.7-m) wide unpaved access road will be used for vehicle movement between US-23 and the shoreline construction site. Its preparation will result in the destruction of about 1,200 sq ft (112 sq m) of terrestrial vegetation. While the magnitude of this impact will be discernible, the importance value of this

impact is rated as minimal due to the abundance of vegetation in the area. Following construction, the soil compacted by the trucks will be tilled and replanted, as recommended in Section 1. Local birds will likely be disturbed by construction activities and related noise. Due to the temporary nature of such an impact, magnitude and importance ratings are minimal.

4.13 The health and safety of nearby residents will be impacted by groin construction, as noise and traffic activity will persist for some length of time (about ten working days). Since the construction activities will lead to a mitigation of shoreline erosion and will benefit nearby residents, it is expected that they will accept such interferences. Motorist safety on U.S. Route 23 may be hampered somewhat particularly at the junction of the highway and the construction site access road. Magnitude and importance values of this impact are expected to be insignificant in view of the small number of trucks involved and the exclusion of construction vehicle activtiy from weekend peak highway traffic periods.

4.14 The use of trucks and other equipment, as required during groin construction will result in exhaust emissions and a localized decrease in air quality. The magnitude of this impact is expected to be minimal due to the relatively low amount of exhaust emissions. Considering 40 truck-loads total or about 6 loads per truck-day (depending on distance to quarry site), groin construction would take about 7 working days (assuming only one truck is used). This region boasts very good air quality and the temporary and localized nature of exhausts indicate an impact of insignificant importance.

4.15 Equipment noise will also adversely impact the environment at the construction site. For groin construction alone, a

truck is expected to arrive once an hour or so for about 7 days. Noise impacts are expected to be discernible in magnitude with an importance rating of minimal.

4.16 Shoreline serenity, aesthetics, and recreation will be adversely impacted due to groin-construction activities. For the duration of the project, equipment noise and the mere presence of groin material will be disquieting and unsightly. The project has been proposed for initiation in the summer between late June and mid-September. Thus, summer residents and visitors will be affected. The overall impacts affecting these environmental factors will be temporary and localized, resulting in ratings of discernible magnitude, but insignificant importance.

4.17 Groin construction will require the employment of about 4 construction workers, thereby enhancing the overall employment picture. However, only an insignificant impact will be realized due to the relatively small scale and temporary nature of the proposed project.

Construction of Beach-Fill Area

4.18 The second action aspect involves the placement of about 3,000 cubic yards (2,300 cu m) of imported beach fill to the north of the groin. The 450-foot (137-m) stretch of eroding beach extending northward from the groin to the existing shore protection structures would receive the fill material. Construction would build-up the beach to a 3-foot (0.9-m) height level with the existing shore bluff. Initial construction would extend the shoreline in this area an average of 60 feet (18.3 m) lakeward of its present position. Only one such fill process will be required. The total time required for beach fill activities is expected to be about one month, and will be conducted concurrently with groin construction activities.

4.19 The number of truck-loads of material required for the beach-fill program can be calculated as follows: 3,000 cubic yards (2,300 cu m) of material is needed; an average-sized truck can carry about 8 cubic yards (6.1 cu m); therefore, 375 truck-loads $\left(\frac{3,000}{8} = 375\right)$ will be needed. Considering a truck may make 6 trips a day (depending on the distance to the quarry), 63 truck-days $\left(\frac{375}{6} = 62.5\right)$ will be required. Assuming construction will last one month (20 working days), then at least 3 trucks $\left(\frac{63}{20} = 3.1\right)$ will be in use full-time during beach-fill operations. This is in addition to the single truck working 7 days that is required for groin construction. Three additional truck drivers will be needed, bringing the total construction crew for both groin construction and beach filling to 7 workers.

4.20 As with groin construction, beach fill is a short-term construction activity that will not, by itself, affect long-term shoreline stability. Beach fill will modify the shoreline; associated impacts are discussed in the next subsection. Accretion is affected by beach construction in that the actual placement of material on the beach can be considered accretion. A beach will be created that is about 450 feet (137 m) long and 60 feet (18.3 m) wide, resulting in a benefit of minor magnitude and insignificant importance. Harbor-induced erosion at the site of construction will be eliminated along the 450-foot (137-m) stretch of beach. The magnitude and importance values for this benefit will both be moderate in this case.

4.21 The placement of foreign material along the shoreline will, understandably, impact the existing habitat. Initial placement of 3,000 cubic yards (2,300 cu m) in the 450-foot-by-60-foot (137-m-by-18-m) zone will cover about 27,000 square

feet (2,500 sq m) of benthic habitat. Natural processes of wave action and littoral transport are expected to distribute this material to a configuration according to shoreline equilibrium demands. The final configuration is difficult to predict, but it is believed that some material will migrate lakeward of its initial placement and cover an additional 10,000 sq ft (930 sq m) of benthic habitat. Thus, a total of about 37,000 sq ft (3,430 sq m) of benthic habitat will eventually be covered by the beach-fill aspect of the proposed plan.

4.22 In order to minimize the overall impact of placing material in the littoral zone, it has been recommended that the required fill should match the characteristics of the native material as closely as possible (as outlined in Section 1). Considering the area involved and the type of material to be used, the impact to the benthic habitat by this action aspect is expected to be moderate in magnitude. In view of the great expanse of benthic habitat in the regions that is similar to the proposed construction site, the importance value of this impact will be minimal.

4.23 Benthic organisms will be smothered by beach fill activities; all organisms that do not escape will likely perish. Although the number of organisms thus affected is presently unknown, such wave-washed and gravel-strewn habitat areas are normally considered to be quite rich in aquatic fauna. The use of fill material with characteristics similar to the natural condition will facilitate recolonization of benthic organisms and reduce adverse impact. The magnitude of this impact is expected to be moderate. Since many miles of shoreline of this type exist in the region, the importance rating for this impact is minimal.

4.24 As wave action redistributes the beach fill material, the smaller, lighter particles will likely become suspended in nearshore waters. Such material is expected to be no smaller than fine sand, which has a relatively fast rate of descent in water. The resultant turbidity will thus be temporary and localized, resulting in insignificant impacts. Water quality will be insignificantly degraded due to increased turbidity. The source for beach fill will be a quarry site within the region that supplies clean, graded material.

4.25 Plankton and aquatic plants will suffer secondary adverse impacts from increased turbidity. However, such impacts will be insignificant in magnitude and importance due to the temporary and localized nature of the turbidity.

4.26 Certain fish utilize the nearshore area of Lake Huron for spawning and foraging; beach-fill construction presents a potential adverse impact to such fish species. In order to minimize the effect of the proposed project, it has been recommended by Michigan's Department of Natural Resources, Fisheries Division, that construction take place after late June and before mid-September. Within this time frame, construction would most likely minimize impacts to fish and fishery activities. Any adverse impacts, should they occur, would most likely be low in magnitude and not of any significance to harm the local fauna.

4.27 Beach construction materials will be delivered by truck, as previously noted. Two access roads are currently anticipated connecting U.S. Route 23 with the construction site. One access road was previously considered in discussions of groin construction; it is anticipated that this road would

also be used to deliver beach fill during this second aspect of construction. In addition to this new road, an existing hard-dirt driveway connecting Route 23 with the shoreline near the mid-point of the erosion pocket is available for use. Following construction activities, both access roads will be tilled and, if necessary, replanted with vegetation which will provide a matted root. Impacts to terrestrial vegetation are, therefore, expected to be minor in magnitude and minimal in importance.

4.28 As calculated previously, about 375 truck-loads would be required to accomplish beach construction. Assuming a 20-day period for beach fill, approximately 19 truck-loads $\left(\frac{375}{20} = 18.8\right)$ would arrive at the site in each 8-hour workday, indicating a truck arriving at the site every 25 minutes $\left(\frac{8}{19} = .42\right)$. This additional traffic on U.S. Route 23 will result in a slight increase in the maintenance of this roadway structure. The actual increment, however, would be immeasurably small and equivalent to an impact of insignificant magnitude and importance. Such traffic, combined with other light equipment necessary for beach construction, will result in localized and temporary impacts to the shorebird population. Impacts are considered to be minimal since the activity will probably last for one month and many miles of adjacent shoreline are available for shorebird use.

4.29 The health and safety of local residents and tourists will be endangered by the increased truck traffic on U.S. Route 23 and other as-of-yet unidentified routes leading from the quarry to the construction site. Due to the relatively remote character of the site, impacts are expected to be insignificant in magnitude and importance.

.30 Air quality will be degraded on a localized and temporary scale by exhaust emissions from trucks and construction equipment. The magnitude of this impact will be minimal. Due to the relatively unpolluted nature of Presque Isle's air quality the importance of this impact is considered insignificant.

4.31 The use of light equipment on the beach and the arrival of a large truck every 25 minutes will certainly increase the noise level at the site. Noise impacts will be moderate in magnitude and minimal in significance. The serenity, aesthetic quality, and recreation potential associated with the shoreline will also be degraded due to beach construction. Since implementation of the proposed project is recommended for the summer season, the shoreline will probably be in use by beach-strollers, bathers, fishermen, and other persons seeking outdoor enjoyment. These factors would be impacted to a discernible magnitude by beach construction. The importance of this impact, however, is deemed insignificant.

4.32 Employment would be enhanced insignificantly by this action aspect, since at least three truck drivers will be employed full-time for one month.

Modification of the Shoreline

4.33 The third action aspect is really a result of the first two. Shoreline modification involves the concept of changing the current shape of the shoreline by placing a groin and beach fill where there was none previously. This aspect considers the long-term implications of altering the current nearshore processes to effect a change in erosion trends.

4.34 A natural balance between shore erosion and accretion is maintained by the physical laws of littoral transport. The resultant state of dynamic equilibrium is referred to as shoreline stability. Prior to the construction of Hammond Bay Harbor in 1962-1963, the shoreline between Pond Point and Highway Point was, overall, a stable one. Since harbor construction, shoreline stability in the area has been disrupted. Thus, the object of the proposed plan is to mitigate erosion, restore natural accretion trends, and ultimately re-establish shoreline stability.

4.35 The action aspects of groin construction with artificial fill combine to mitigate harbor-induced erosion. The groin is necessary to prevent the further transport of littoral drift into the accreting harbor fillet. Without the beach-fill process, the shoreline north of the proposed groin would erode to the extent of providing enough material to fill the groin through natural processes. An estimated 3,000 cubic yards (2,300 cu m) of material is required to fill the groin. The additional area of land loss needed to provide the material is about 9,000 square feet (840 sq m). This would require (without the beach-fill aspect) an average retreat of 5 feet (1.5 m) by the contributing 1,800 feet (550 m) of shoreline. Thus, beach fill will modify the shoreline in such a way as to save this 9,000 square feet (840 sq m) of land.

4.36 Impacts resulting from such action are beneficial and are considered to be significant for both shoreline stability and erosion. Accretion will merely be returned to a natural rate in order to balance the erosion. Thus, the shoreline will not experience net accretion, but will rather be

returned to a state of dynamic equilibrium. Impacts to accretion resulting from shoreline modifications are expected to be minor.

4.37 The stabilization of the shoreline will have a secondary beneficial effect on the adjacent benthic habitat. As erosion abates along the 1,800 feet (550 m) of shoreline north of the groin, the nearshore benthic region will also become stabilized to a minimal degree; such limited stabilization is insignificant in this region. Likewise, benthic organisms will benefit only insignificantly from modification of the shoreline.

4.38 Currently, shoreline trees, shrubs, and other such vegetation are falling into the Lake as erosion continues. A stand of trees lining the shoreline north of the existing protection structures are threatened by a receding shoreline. Implementation of the proposed plan and the attending modifications of the shoreline will serve to protect these and other vegetation types. Impacts will be discernible in magnitude and minimal in importance.

4.39 Landowner concern for eroding properties would be diminished to a certain degree by a workable erosion mitigation plan. This would result in benefits to those few residents and owners involved with lands north of the proposed beach fill. Impacts would be minor in magnitude, but significant in importance.

4.40 Modification of the shoreline will have conflicting impacts on the factor of aesthetics. A new beach and the abatement of erosion will improve the general aesthetics of the area. However, the existence of a groin in the nearshore

one will be aesthetically displeasing and unnatural. The net effect on areal aesthetics will be a benefit of insignificant degree and magnitude relative to the current existing situation. The improvement, however, cannot be expected to replace the natural beach beauty which existed prior to harbor construction.

.4. Recreation will benefit to a discernible degree from the new groin and beach area. Sportsmen are expected to utilize the groin for fishing; the beach area will be excellent for sun-bathing and beach-strolling. Since many miles of such shoreline do already exist in the area, and in view of the limited tourism here, the importance of this impact is minimal.

.42 In anticipation of a much more developed harbor and boating facility at Hammond Bay Harbor, some of the shoreland to the north of the harbor was platted for seasonal residential structures. Alleviation of the current erosion problem in this shallow bay will allow further expression of the small community in its growth: more of the shoreland will be suitable for residential development. Associated impacts will be discernible in magnitude and moderate in importance. In like manner, land use will benefit as would community growth--residential land use would be enhanced.

.43 Property values will most certainly benefit from the erosion-mitigation plan. Current shoreland values range from $0 per front foot, for land that has eroded to a point of uselessness, to $125 per front foot for good shoreland. About 400 feet (120 m) of lake frontage has eroded to such an extent that, with the potential for continuing damage, it must be considered worthless. Another 600 feet (180 m) will probably

face such a demise if the present rates continue for the next 50 years. Beyond this combined 1,000-foot reach (300-m) is another 800 feet (240 m) which will decline in value but remain buildable. If erosion is stopped, or even substantially reduced, values of the land in all three categories will increase. The possible increases in front-foot value are assumed to be $100, $50, and $25 for each respective category. Benefits will be discernible in magnitude and minor in importance. Structures that are currently being threatened by erosion, such as those shoreward of the existing protection structures and those further back from the eroding shoreline (e.g., U.S. Route 23), would also benefit to a discernible degree by erosion mitigation. Importance values for such benefits are rated as insignificant.

CONSTRUCTION GUIDELINES FOR ENVIRONMENTAL PROTECTION

4.44 In accordance with Guide Specifications Civil Works Construction: Environmental Protection (CE 1300, June 1973) all emitted water, atmospheric, and noise pollutants will be in compliance with Federal, State and local standards.

5. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

5.01 Most of the impacts expected to accompany the proposed project are negative. However, the magnitude rating and the importance values for the most adverse impacts do not exceed moderate (5) and minimal (2), respectively. On the other hand, several of the beneficial impacts resulting from the project have magnitude and importance ratings of significant (6).

5.02 All of the expected adverse impacts will accompany the construction phase of the project. The rock groin and beach construction actions will destroy a total of 40,000 square feet (3,700 sq m) of benthic habitat and organisms. Water turbidity and quality will be temporarily degraded on a localized scale. Such impacts will, in turn, affect plankton, aquatic plants, and fish. Delivery of construction materials will result in the destruction of about 1,200 square feet (112 sq m) of terrestrial vegetation.

5.03 The use of trucks and other heavy equipment during construction will result in impacts due to noise and exhaust emissions. Approximately 415 truck-loads of materials will be required for the project, in addition to the light equipment used for rock placement and beach construction. Air quality, birds, noise, and the health and safety of shoreline residents will be negatively impacted. In addition, the construction activity will result in negative impacts to shoreline serenity, aesthetics, and recreation for the duration of construction. It is significant to note that nearly all expected adverse impacts will not continue after necessary construction activity has ceased.

6 ALTERNATIVES

6.01 In reviewing this statement and reflecting upon the proposed action, certain alternatives will no doubt come to mind concerning the mitigation of shore damage in the Hammond Bay Harbor vicinity. Alternatives do exist and were given due consideration while formulating the project plan. The planning team selected twelve alternatives for special evaluation. Each alternative was assessed for its primary beneficial and adverse effects on environmental quality (EQ) and national economic development (NED). Secondary consideration was given to the beneficial and adverse effects of each alternative on social well-being (SWB) and regional development (RD). Alternative plans were categorized as non-structural or structural, as follows:

Non-Structural Alternatives

1. No action
2. Riparian zone management

Structural Alternatives

3. Modification of navigation structures
4. Complete removal of navigation structures
5. Protective beaches
6. Feeder beaches
7. Nearshore nourishment sites
8. Continuous armor protection
9. Groins at shoreline damage area
10. Artificially filled groins at shoreline damage area
11. Offshore breakwaters
12. Offshore breakwaters and beach nourishment

6.02 In reviewing and assessing these alternatives, it is important that the following facts be considered. The Section 111 authority states that the Corps of Engineers is authorized to study and recommend the mitigation of damages attributable to Federal navigation works when equitable and in the public interest fully considering the preproject conditions and tangible and intangible benefits. This authority is not intended to provide mitigation measures of such magnitude as to approach the extent of protection usually associated with the development of regular beach erosion control projects. As part of the Section 111 Study of Hammond Bay Harbor, alternatives to the proposed action were given individual consideration of their applicability under the authorization and compatibility with existing and future economic and environmental factors. Table 18 summarizes significant impacts associated with these alternative plans. Environmental Quality (EQ) and National Economic Development (NED) are considered as equal national objectives. Social Well-Being (SWB) and Regional Development (RD) are secondary objectives under EQ and NED respectively.

6.03 Alternative 1: No Action. A "no-action" alternative is available for selection under Section 111 of Public Law 90-483. By taking no action, Federal project expenses are minimized while a refuge harbor is maintained. Existing shoreline erosion and accretion trends and property losses would be perpetuated. There would be no mitigation of harbor-induced erosion damage in the vicinity, and Federal responsibility for damage would continue. If local concerns invest capital in shore protection, local economic resources would be diminished. Selection of the no-action alternative should be reserved for cases where other

TABLE 18

ASSESSMENT OF IMPACTS ASSOCIATED WITH ALTERNATIVE PLANS

A summary environmental and economic assessment for each alternative plan is presented in this table. Corresponding information for the proposed project plan is made available for comparison. Additional information about the timing, uncertainty, exclusivity, and actuality of expected impacts is provided using footnotes following the described index:

INDEX OF FOOTNOTES

TIMING

1. Impact will occur prior to or during plan implementation.
2. Impact will occur within 15 years following plan implementation.
3. Impact will occur 15 years or longer following plan implementation.

UNCERTAINTY

4. Uncertainty associated with the impact is 50% or more.
5. Uncertainty associated with the impact is between 10% and 50%.
6. Uncertainty associated with the impact is less than 10%.

EXCLUSIVITY

7. Impact is repeated and fully monetized in NED category.
8. Impact is repeated but not fully monetized in NED category.

ACTUALITY

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #1, NO ACTION
Environmental Quality (EQ)	
-EQ enhanced	continue accretion areas for recreation (1,6,9);
-EQ degraded	continue: erosion, loss of land, vegetation loss, littoral instability (1,6,9);
-EQ destroyed	destroy: beaches, land, vegetation, submerged nearshore rocky habitat (1,6,9).
Social Well-Being (SWB)	
-Benefits	enhance accretion areas for recreation (1,6,9);
-Detriments	continue: property loss, property value decline, owner concern (1,6,9).
National Economic Development (NED)	
-Benefits	minimize Federal expense (1,6,9), maintain recreational and refuge harbor (1,6,9
-Detriments	continue: Federal damage responsibility (1,6,9), structural/property loss (1,6,9 economic resources drain (1,6,10);
-Net NED benefits	maintain economic efficiency.
Regional Development (RD)	
-Benefits	continue recreational activity (1,6,9), maintain recreational and refuge harbor (1,6,9), encourage community development (1,6,9);
-Detriments	continue local economic resources drain (1,6,9).

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #2, RIPARIAN ZONE MANAGEMENT
Environmental Quality (EQ)	
-EQ enhanced	reduce aggravation of erosion due to uncoordinated shore protection efforts (2,6,10), continue accretion areas for recreation (1,6,9);
-EQ degraded	continue: erosion, loss of land, vegetation loss, littoral instability (1,6,9);
-EQ destroyed	destroy: beaches, land vegetation, submerged nearshore rocky habitat (1,6,9).
Social Well-Being (SWB)	
-Benefits	encourage planned community growth (2,5,10), enhance accretion areas for recreation (1,6,9), reduce: structural loss (2,6,10), owner concern (1,6,10);
-Detriments	limit personal freedom for private land use and protection (1,6,10), result in structural relocation (2,5,10), continue: property loss, property value declin owner concern (1,6,9).
National Economic Development (NED)	
-Benefits	maintain recreational and refuge harbor (1,6,9), minimize Federal expense (1,6,9
-Detriments	continue: Federal damage responsibility (1,6,9), property loss (1,6,9), economic resources drain (1,6,10);
-Net NED benefits	maintain economic efficiency (1,6,9).
Regional Development (RD)	
-Benefits	encourage: planned community growth (2,5,10), coordination with Federal government (1,6,9), continue: recreational activity (1,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	reduce shoreline property values.

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #3, MODIFICATION OF NAVIGATION STRUCTURES
Environmental Quality (EQ)	
-EQ enhanced	reduce: littoral processes interference, erosion, loss of land and vegetation (1,6,9);
-EQ degraded	reduce: beach area fillet, submerged nearshore rocky habitat (1,6,9);
-EQ destroyed	temporarily destroys benthic habitat and organisms at site (1,6,9).
Social Well-Being (SWB)	
-Benefits	eventually reduce: erosion damage, property loss, owner concern (2,6,9);
-Detriments	increase navigation hazard (1,6,9).
National Economic Development (RD)	
-Benefits	eventually reduce Federal damage responsibility (2,4,9);
-Detriments	incur high Federal expense (1,6,9), increase navigation hazards (1,6,9);
-Net NED benefits	none (costs exceed benefits).
Regional Development (RD)	
-Benefits	eventually reduce property loss due to navigation structures (3,6,9);
-Detriments	reduce recreation potential (1,6,9).

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #4, COMPLETE REMOVAL OF NAVIGATION STRUCTURES
Environmental Quality (EQ)	
-EQ enhanced	reduce: erosion, littoral instability, loss of land (2,6,9);
-EQ degraded	reduce: beach area of accreted fillet, submerged nearshore rocky habitat (1,6,'
-EQ destroyed	temporarily destroy benthic habitat and organisms at site (1,6,9).
Social Well-Being (SWB)	
-Benefits	eventually reduce erosion damage, property loss, owner concern (3,6,9);
-Detriments	reduce: recreation potential (1,6,9), property values (2,4,9), increase: unemployment (2,5,9), navigation hazard (1,6,9).
National Economic Development (NED)	
-Benefits	eliminate: Federal damage responsibility (3,6,9), Federal maintenance costs (1,6,9);
-Detriments	incur extreme Federal expense (1,6,9), eliminate recreational and refuge harbor (2,5,9);
-Net NED benefits	none (costs exceed benefits).
Regional Development (RD)	
-Benefits	eventually reduce property loss due to navigation structures (3,6,9), (2,5,9);
-Detriments	eliminate recreational maritime activity (1,6,9), increase unemployment (2,5,9) eliminate returns on capital investments in harbor (1,6,9).

TABLE 16. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #5, PROTECTIVE BEACHES
Environmental Quality (EQ)	
-EQ enhanced	reduce: erosion, littoral instability, loss of land (1,6,9), provide accretion areas (1,6,9);
-EQ degraded	result in periodic beach damage by equipment (1,5,9), increase turbidity temporarily (1,6,9), degrade site of land borrow (1,5,9);
-EQ destroyed	result in periodic burial of beach organisms (1,6,9).
Social Well-Being (SWB)	
-Benefits	reduce: erosion damage, property loss, owner concern (1,6,9), provide accretion areas for shore protection and recreation (1,6,9);
-Detriments	result in periodic beach construction nuisance and interference with seasonal recreation (1,5,9).
National Economic Development (NED)	
-Benefits	reduce: Federal damage responsibility, economic resources drain (1,6,9), maintains recreational and refuge harbor (1,6,9);
-Detriments	incur moderate Federal expense and annual replenishment costs (1,6,9);
-Net NED benefits	none (costs exceed benefits).
Regional Development (RD)	
-Benefits	reduce property loss due to navigation structures (1,5,9), maintain recreation and refuge harbor (1,6,9);
-Detriments	none.

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #6, FEEDER BEACHES
Environmental Quality (EQ)	
-EQ enhanced	reduce: erosion, littoral instability, loss of land (1,6,9), provide accretion areas (1,6,9);
-EQ degraded	increase turbidity temporarily (1,6,9), degrade site of land borrow (1,5,9);
-EQ destroyed	result in periodic burial of beach organisms (1,6,9).
Social Well-Being (SWB)	
-Benefits	reduce: erosion damage, property loss, owner concern (1,6,9), provide accretion areas for shore protection and recreation (1,6,9);
-Detriments	result in periodic beach construction nuisance and interference with seasonal recreation (1,5,9).
National Economic Development (NED)	
-Benefits	reduce: Federal damage responsibility (1,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	incur moderate Federal expense and annual replenishment costs (1,6,9);
-Net NED benefits	none (costs exceed benefits).
Regional Development (RD)	
-Benefits	reduce property loss due to navigation structures (1,5,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	none.

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #7, NEARSHORE NOURISHMENT SITES
Environmental Quality (EQ)	
-EQ enhanced	reduce: erosion, littoral instability, loss of land (1,6,9), provide accretion areas (1,6,9);
-EQ degraded	increase turbidity (1,6,9), reduce submerged nearshore rocky habitat (1,5,9);
-EQ destroyed	periodically destroy plankton, fish eggs and larvae, benthic organisms (1,6,9).
Social Well-Being (SWB)	
-Benefits	reduce: erosion damage, property loss, owner concern (1,6,9), provide accretion areas for shore protection and recreation (1,6,9);
-Detriments	result in periodic noise problem (1,6,9).
National Economic Development (NED)	
-Benefits	reduce: Federal damage responsibility (1,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	incur high Federal expense and annual replenishment costs (1,6,9);
-Net NED benefits	none (costs exceed benefits).
Regional Development (RD)	
-Benefits	reduce property loss due to navigation structures (1,6,9), maintain recreationa and refuge harbor (1,6,9);
-Detriments	none.

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #8, CONTINUOUS ARMOR PROTECTION
Environmental Quality (EQ)	
-EQ enhanced	eventually eliminate: erosion, loss of land (2,5,9);
-EQ degraded	require continuous belt of armor (2,6,9), reduce: beach area, vegetation, benthic communities, lake access (1,6,9);
-EQ destroyed	destroy: beaches, benthic habitat, beach organisms.
Social Well-Being (SWB)	
-Benefits	eventually eliminates: erosion damage, property loss (2,5,9);
-Detriments	reduce: available recreation beach, lake access, personal safety (1,6,9), shoreline aesthetics (1,6,9).
National Economic Development (NED)	
-Benefits	eliminate Federal damage responsibility (2,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	incur moderate Federal expense (1,6,9);
-Net NED benefits	maintain economic efficiency.
Regional Development (RD)	
-Benefits	eliminate: property loss due to erosion (2,6,9), requirement for additional shore protection (3,5,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	reduce: beach attractiveness, recreation potential (2,6,9).

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #9, GROINS
Environmental Quality (EQ)	
-EQ enhanced	reduce: erosion, loss of land (1,6,9), eventually provide accretion areas (2,6,9), provide increased rocky habitat (1,6,9);
-EQ degraded	benthic habitat altered (1,6,9), construction noise and nuisance (1,6,9);
-EQ destroyed	destroy benthic organisms at construction sites (1,6,9).
Social Well-Being (SWB)	
-Benefits	reduce: erosion damage property loss, owner concern (1,6,9);
-Detriments	threatens shoreline aesthetics (1,6,9), reduces personal safety (1,6,9).
National Economic Development (NED)	
-Benefits	reduce Federal damage responsibility (1,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	incur moderate Federal expense (1,6,9);
-Net NED benefits	maintain economic efficiency.
Regional Development (RD)	
-Benefits	reduce: property loss due to navigation structures (1,6,9), requirements for additional shore protection (2,6,9), maintain recreation and refuge harbor (1,6,9);
-Detriments	none.

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #10, ARTIFICIALLY-FILLED GROINS
Environmental Quality (EQ)	
-EQ enhanced	reduce: erosion, loss of land (1,6,9), provide: accretion area, increas rocky habitat (1,6,9);
-EQ degraded	benthic habitat altered (1,6,9), construction noise and nuisance (1,6,9) land borrow site altered (1,6,9)
-EQ destroyed	destroys benthic organisms (1,6,9).
Social Well-Being (SWB)	
-benefits	reduce: erosion damage, property loss, owner concern (1,6,9);
-Detriments	threatens shoreline aesthetics (1,6,9), reduces personal safety (1,6,9).
National Economic Development (NED)	
-Benefits	reduce Federal damage responsibility (1,6,9), maintain recreational and harbor (1,6,9);
-Detriments	incur moderate Federal expense (1,6,9);
-Net NED benefits	maintain economic efficiency.
Regional Development (RD)	
-Benefits	reduce: property loss due to navigation structures (1,6,9), requirements additional shore protection (2,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	none.

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #11, OFFSHORE BREAKWATERS
Environmental Quality (EQ)	
-EQ enhanced	reduce: erosion, loss of land (1,6,9), provide: accretion areas, increased rocky habitat (1,6,9);
-EQ degraded	reduce open water (1,6,9), balance in ecosystem disturbed (1,6,9), construction noise and nuisance (1,6,9);
-EQ destroyed	destroy natural beach processes (1,6,9), benthic organisms at sites (1,6,9).
Social Well-Being (SWB)	
-Benefits	reduce: erosion damage, property loss, owner concern (1,6,9);
-Detriments	threaten shoreline aesthetics (1,6,9), reduce navigation safety (1,6,9).
National Economic Development (NED)	
-Benefits	reduce Federal damage responsibility (1,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	incur extreme Federal expense (1,6,9);
-Net NED benefits	none (costs exceed benefits).
Regional Development (RD)	
-Benefits	reduce: property loss due to navigation structures (1,6,9), requirements for additional shore protection (2,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	none.

TABLE 18. (Cont'd.)

IMPACTED FACTOR	IMPACTS OF ALTERNATIVE #12, OFFSHORE BREAKWATERS AND BEACH NOURISHMENT
Environmental Quality (EQ)	
-EQ enhanced	reduce: erosion, loss of land (1,6,9), provide: accretion areas, increased rocky habitat (1,6,9);
-EQ degraded	reduce: open water (1,6,9), balance in ecosystem disturbed (1,6,9), constructi noise and nuisance (1,6,9);
-EQ destroyed	destroy: plankton, fish eggs and larvae, benthic organisms (1,6,9).
Social Well-Being (SWB)	
-Benefits	reduce: erosion damage, property loss, owner concern (1,6,9);
-Detriments	threaten shoreline aesthetics (1,6,9), reduce navigation safety (1,6,9).
National Economic Development (NED)	
-Benefits	reduce Federal damage responsibility (1,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	incur extreme Federal expense (1,6,9);
-Net NED benefits	none (costs exceed benefits).
Regional Development (RD)	
-Benefits	reduce: property loss due to navigation structures (1,6,9), requirements for additional shore protection (2,6,9), maintain recreational and refuge harbor (1,6,9);
-Detriments	none.

alternatives are unsuitable environmentally and economically.

6.04 Enhancement of environmental quality would continue as accretion areas provide for recreation. Erosion, loss of land and vegetation, and littoral instability would continue to degrade the environment. A "no-action" alternative would perpetuate the destruction of beaches, land, vegetation, and submerged nearshore rocky habitat (by accretion). Continued property loss and property value decline in areas north of the harbor would result in owner concern and adverse impacts to social well-being.

6.05 Alternative 2: Riparian Zone Management. Regulation and management of shorelands is normally a prerogative reserved to state and local governments. Traditionally this might include zoning, subdividion regulation, building codes, ordinances, permits, acquisition, taxes, condemnation, and evacuation. The State of Michigan Shorelands Management and Protection Act of 1970, as amended by Act 270, Public Acts of 1974, provides that until July 1, 1975, all local units of government (cities, villages, counties, and townships) which are situated along the shores of the Great Lakes may zone any shoreland and land within their jurisdiction. The State Water Resources Commission shall determine if any zoning ordinance which regulates a high risk area adequately prevents property damage. The Commission had 18 months after the effective date of the Act to prepare a plan for the use and management of the shorelands. Additionally, the Commission had 1 year to make an engineering study of the shoreland to determine (among other things) the high risk areas and to develop alternatives for the best means of preventing such erosion. By legislative Act Number 270 of 1974, the ef-

fective date was delayed to July 1, 1975. The State of Michigan has completed the designation of some high-risk erosion areas in Presque Isle County, including reaches of about 1,500 feet on either side of Hammond Bay Harbor. No set-back regulations for new construction have yet been set for those reaches. As of May 1976, no regulatory actions had been taken by Presque Isle County or by Bearinger Township in furtherance of the Act.

6.06 The Corps of Engineers has no authority to establish zoning regulations. It may, however, promote the practice of riparian zone management through such means as establishing public information and education programs, restricting the construction of shore protection works in navigable waters, and other non-structural actions.

6.07 Riparian zone management would not reduce the erosion damage resulting from the harbor structures. It would, however, decrease the likelihood of property loss and human misfortune. Careful consideration of the probable effects of private shore protection works before issuing construction permits would minimize aggravation of erosion problems by private parties. By conducting an active public information program about prevailing erosion risks and methods of minimizing losses, the public is more capable of making intelligent decisions regarding development of riparian property.

6.08 Alternative 3: Modification of Navigation Structures. The purpose of modification of the navigation structures is to eliminate or minimize the interference of the harbor with shoreland processes through redesign. Three possibilities include

reorientation of breakwaters, a change in the cross-sectional design of the breakwaters, and removal of some of the structures. Since the erosional problems are mostly due to the disturbance of littoral drift patterns, is is likely that the only effective solution would be to either completely reshape the harbor or remove a large part of the structures. The first alternative would be of dubious value without extensive pre-construction model studies, and the second would probably destroy the serviceability of the harbor as a refuge facility. Either would entail large expenditures of capital.

6.09 Alternative 4: Complete Removal of Navigation Structures. Complete removal of the navigation structures would result in immediate mitigation of harbor-induced erosion north of the harbor. The large north fillet would begin to erode and continue to do so until a natural balance and shape is restored. Harbor utilization would be shifted to the nearest refuge harbor at Rogers City. Submerged rocky habitat associated with the navigation structures would be removed, temporarily destroying benthic organisms at the site.

6.10 Beneficial impacts to social well-being would eventually result from reductions in erosion damage, property loss, and owner concern. However, the Hammond Bay Harbor was justified as a harbor of refuge in the "chain of harbors" for Lake Huron. Its removal would affect the general safety of boaters in northwest Lake Huron by significantly increasing the distance to a small-craft harbor suitable as a refuge. Removal should be based only on a showing of greater public hazard by its continued existence than by its removal.

6.11 Alternative 5: Protective Beaches. When constructed in areas of erosion, protective beaches are an effective means of reducing erosion. Depending on the quality and quantity of the beach fill material, erosion can be completely stopped and provide additional beach areas. Beach fill may be obtained by using dredge tailings or borrowing from sand pits or land quarries. The principal adverse impacts are the construction nuisances. These include interruption of beach availability and, if required, the presence of heavy earth-moving equipment. To be effective at Hammond Bay Harbor, the shoreline would have to be moved far lakeward or large fill quantities would be needed annually to satisfy the littoral drift potential. Because of the large quantities of fill required, the costs would exceed benefits.

6.12 Protective beaches would result in reduced erosion, a more stable littoral zone, and specific accretion areas. Protective beach construction, however, would result in periodic localized turbidity and beach damage. Beach organisms such as amphipods, tubificid worms, insect larvae, and perhaps molluscs would be destroyed by heavy equipment operation and material placement. The land-fill borrow site used to supply required materials would be degraded. Reduced erosion damage and property loss would lessen owner concern. Protective beaches would provide recreation and shore-protection areas. Periodic beach construction activities would be a nuisance, interfere with seasonal recreation, and disrupt shoreline aesthetics.

6.13 Construction of protective beaches would reduce Federal shore damage responsibility and the accompanying economic resources drain while maintaining a refuge harbor. Moderate Federal expenses and annual replenishment costs would be in-

curred. There would be no net benefit to national economic development since costs of this alternative exceed expected benefits. Regional development would benefit from Alternative #5 in that property loss would be reduced and a refuge harbor would be maintained.

6.14 Alternative 6: Feeder Beach. The feeder beach concept is similar to the protective beach concept, except that, in lieu of distributing material mechanically along the erosion zone, feeder beaches depend upon wave action to distribute the material. A small decrease in relative effectiveness is expected. Environmentally, this concept would result in impacts similar to those expected for Alternative #5, but with minimal construction nuisance. Like the protective beach concept, feeder beaches will not result in a favorable benefit-cost ratio.

6.15 Alternative 7: Nearshore Nourishment Sites. The nearshore nourishment concept is analagous to the feeder beach concept in that material is placed for distribution by littoral processes to the areas of need. The major difference is that the feeder material, usually available as a result of maintenance dredging, would be placed in nearshore waters. Effectiveness would increase as the material is placed in shallower water but so would the placement costs. Generally, this alternative is less effective than feeder or protective beaches, and is not currently feasible at Hammond Bay Harbor since annual dredging is not accomplished. Environmentally, nearshore nourishment sites would have minimal adverse impacts. Despite the low placement costs of this alternative, it has a highly adverse benefit-cost ratio, especially in view of the lack of any dredge site nearby.

6.16 Establishment of nearshore nourishment sites would return littoral stability, reduce erosion and land loss and provide areas of accretion. Turbidity would be temporarily increased at the dumping site, and nearshore rocky habitats may be covered with disposed material. Shoreline nourishment would periodically destroy plankton, fish eggs and larvae, and benthic organisms. Owners of shoreline property would be somewhat relieved by reduced erosion damage and property loss. Areas of induced accretion would provide further social benefits in the form of shore protection and recreation lands. Periodic nuisances would result from barge noise, lights, and traffic.

6.17 Nearshore nourishment, like protective and feeder beach alternatives, would reduce Federal damage responsibility while maintaining harbor effectiveness. Alternative #7 would require moderate Federal expense plus annual replenishment costs. Net benefits to national economic development are not expected since costs exceed benefits. Regional development would benefit from reductions in property loss and local economic resources drain, and maintenance of a refuge harbor.

6.18 Alternative 8: Continuous Armor Protection. The degree of protection afforded by this alternative is very high. An adequate design would stop all harbor-induced erosion as well as any natural erosion. Continuous armor protection would deprive the littoral stream of its natural input from bluff erosion; this would cause the erosion problem to move downdrift and thereby necessitate more protective work. Shore protection of this type (such as rip-rap) is generally aesthetically unattractive or, if designed to be more attractive, extremely expensive (such as seawalls). Because of the extent of protection provided by this alternative, the scope approaches that

of a regular beach erosion control project. Consideration is warranted primarily by showing that damage is wholly caused by the harbor in the area where protective material would be placed. In view of the exceptionally high cost of seawalls further consideration is limited to the armor (rip-rap) alternative.

6.19 Alternative #8 would eventually eliminate erosion and loss of land in the study area. However, material demand would merely shift to downstream shores, necessitating an eventual continuous belt of armor protection. Material lakeward of such shore protection would be lost due to scour. The resultant shoreline would include reduced beach areas, vegetation, and sandy beach biotic communities. Shore protection would also limit lake access by animals. Benthic habitat and organisms would be destroyed during armor construction. Eventual elimination of erosion damage and property loss would benefit community well-being. However, shoreline alterations resulting from this alternative would reduce available recreation beach and lake access. The personal safety of boaters attempting shore landing would be jeopardized. Continuous shore protection would threaten the area's shoreline aesthetics and attractiveness.

6.20 Construction of continuous shoreline armor would be extremely expensive. Such action would mitigate all erosion and eliminate Federal shore damage responsibility. Costs to the Federal government would exceed accrued benefits. Alternative #8, while eventually eliminating property loss due to erosion, would also reduce beach attractiveness and recreation potential. Regional development would not suffer significantly, since harbor utilization would continue.

6.21 Alternative 9: Groins at Shoreline Damage Area. The construction of groins entails excavation at selected sites, followed by placement of various-sized stone. The shore protection constructed privately just north of the harbor has operated much like a short groin. The beach to the immediate north has been nearly stabilized following its construction, and the erosion hazard to the north was substantially mitigated. Erosion continued to the south between the shore protection and the fillet and was probably actually aggravated. If carefully designed, a single groin placed near the first signs of erosion north of the harbor would probably substantially reduce erosion to the north over the long term, since some time would be required for the groin to impound enough material to slow the transport rate.

6.22 Installation of a groin at the shore damage area would reduce localized erosion, land loss, and bluff sloughing. Groins provide increased rocky habitat and, eventually, allow pockets of littoral material to accrete. Construction activities would destroy benthic organisms at the groin site. Reductions in erosion damage and property loss associated with groin construction would relieve owner concern. Groins, however, threaten shoreline aesthetics, limit access to the lake, and present personal safety hazards.

6.23 Alternative #9 would reduce Federal shore damage responsibility while maintaining a refuge harbor. Regional development would benefit from Federally-financed groin construction by the reduction of property loss and shore protection requirements.

6.24 Alternative 10: Artificially-Filled Groins at Shoreline Damage Area. This alternative would be more effective than unfilled groins. The added effect comes by artificially placing fill material adjacent to the groin. It resembles, therefore, the protective beach concept with the groins inserted to eliminate replenishment requirements.

6.25 This plan would replace the eroded sand beach, effectively reduce shoreline erosion in the damage area, and limit construction nuisance to a one-time occurrence in an isolated area. These factors combine to indicate Alternative #10 as most satisfactory to the interests of environmental quality. Installing a groin and filling a 450-foot (140 m) reach of eroded beach provides the maximum benefits without exceeding Section 111 authority and is economically justifiable. Alternative #10 has been designated as the plan best suited for national economic development.

6.26 This alternative constitutes the proposed plan and has been described in detail in Section 1 of this statement. Impacts associated with the project are presented in detail in Section 4, Impacts of the Proposed Action.

6.27 Alternative 11: Offshore Breakwaters. Offshore breakwaters would dissipate wave energy prior to its incidence upon the beach. Erosion would continue until the area between the breakwaters and the water's edge built up to a stable bottom profile and a protective beach formed. Extended offshore breakwaters would provide local protection in excess of that provided for in the scope of Section 111 and would additionally be so expensive as to make their construction prohibitive.

6.28 Offshore breakwaters would reduce erosion, loss of land, and bluff sloughing while providing increased nearshore rocky habitat and areas of accretion. Additional shore protection would eventually be required, as erosion problems are merely shifted downstream. Littoral stability would be reduced by offshore breakwaters, as would open water. Benthic organisms would be destroyed at the site during breakwater construction. As with other alternatives, reductions in erosion damage and property loss would alleviate owner concern. Social well-being would be adversely affected with breakwater construction as it threatens shoreline aesthetics and reduces navigation safety.

6.29 Federal shore damage responsibility would be reduced under Alternative #11, but extreme Federal expenses would result in no net benefits to natural economic development. Regional development would benefit from Federally-financed offshore breakwater construction by reducing property loss and shore protection requirements.

6.30 Alternative 12: Offshore Breakwaters and Beach Nourishment. Offshore breakwaters and annual beach nourishment would accomplish all of that stated in Alternative #11, but more rapidly. Nourishment would establish a stable bottom profile and a protective beach sooner than if equilibrium developed from materials derived from bluff erosion.

6.31 Alternative #12 is expected to produce effects similar to Alternatives #7 and #11. Offshore breakwaters combined with nearshore nourishment would result in mitigation of erosion damage caused by the navigation structures. The nourishment would serve to alleviate the erosion downdrift

of the structures. Extreme federal costs would result in no net benefits to national economic development.

Selection of the NED and EQ Plans

6.32 Consideration of the aforementioned alternatives was required in the selection of two semi-final plans: one which would provide the greatest net benefits to the nation's economic development (designated as the NED Plan); and a second alternative that would result in the greatest net benefits to environmental quality (the EQ Plan). To facilitate an understanding of the process involved in such selection, Table 19 presents comparative ratings of the 12 alternative plans.

6.33 In this process, each alternative was rated on a sliding scale based on the degree of acceptability assigned for both primary and secondary accounts. Ratings were determined from the previous discussions in this section and from Table 18, Assessment of Impacts Associated With Alternative Plans. The rating scale used in all cases ranged from one (1) to ten (10), where a rating of "1" indicates the highest degree of acceptability.

6.34 The NED Plan. Bold numerals were used in Table 19 to denote those ratings of highest acceptability (1, 2, and 3). Based on both primary and secondary accounts, two alternative plans are designed as potential NED Plans: Alternative 9, Groins at the Shoreline: and Alternative 10, Artificially-Filled Groins. Over sixty percent of the maximum benefit available accrues from preventing the loss of land and appreciation of market values. For this reason, mitigation schemes

TABLE 19

COMPARATIVE RATINGS OF ALTERNATIVE PLANS

ALTERNATIVE	PRIMARY ACCOUNTS		SECONDARY ACCOUNTS	
	NED	EQ	RD	SWB
1. No action	8	8	10	9
2. Riparian Zone Management	7	5	8	6
3. Modification of Navigation Structures	10	6	5	6
4. Removal of Navigation Structures	10	5	10	6
5. Protective Beaches	5	6	**2**	4
6. Feeder Beaches	5	5	**1**	**3**
7. Nearshore Nourishment	9	6	8	6
8. Continuous Armor Protection	4	5	8	6
9. Groins at Shoreline	**2**	**3**	5	**3**
10. Artificially Filled Groins	**1**	**2**	**2**	**2**
11. Offshore Breakwaters	10	8	7	8
12. Offshore Breakwaters and Beach Nourishment	10	9	6	7

Rating system: Alternatives rated on sliding scale from 1 to 10 where a rating of 1 indicates the highest degree of acceptability

that minimize future erosion produce the largest benefits. An unfilled groin would effectively stop erosion at some future date after continuing erosion had filled the groin. An estimated 3,000 cubic yards (2,300 cu m) of material is required to fill the groin. The additional area of land loss needed to provide the material is about 9,000 square feet (840 m). This would require an average of 5 feet (1.5 m) of retreat in the contributing 1,800 feet (550 m) of shoreline. Since intallation of a groin and refilling a 450-foot (137-m) reach of eroded beach would effectively mitigate harbor-caused erosion, would provide the maximum benefits without exceeding Section 111 authority, and is economically justifiable, a filled groin (Alternative 10) is designated as the NED Plan.

6.35 The EQ Plan. Two plans surfaced as potential EQ projects: Alternative 9 and Alternative 10. Two factors received special attention in rating plans in the environmental quality account. These were the degree of stability expected and the extent of damage to the natural setting associated with the plan. A single unfilled groin would be favored were it not for the erosion that would continue until the groin filled sufficiently to limit the erosion rate. The concern over artificially filling a groin stems from several factors. Among these are the destruction of submerged rocky environments, construction nuisances accompanying distribution of the fill, and a potential change in the character of beach material. Since continued rapid erosion of the shoreline is considered to be environmentally damaging, an artificially-filled groin has been selected as the EQ plan provided that certain features are incorporated into the design and planning (identified in Section 1 as mitigation actions).

Plan Selection

6.36 The general philosophy of this study presumes that if the natural shoreline trends have been affected by the harbor structures sufficiently to cause environmental deterioration, then a structural plan of mitigation is preferable to doing nothing so long as it is not, in itself, detrimental.

6.37 Since the preferred NED and EQ plans are identical, the alternative of installing a groin and providing fill to satisfy its immediate demands (Alternative #10) is recommended. The constraints proposed by the EQ plan as conditions of acceptance are considered to be reasonable design constraints. Although they may affect the cost-effectiveness of the plan, the benefit-cost ratio remains high.

7. RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.01 The proposed plan to mitigate erosion attributable to the navigation structures at Hammond Bay Harbor will result in a more stabilized shoreline, a reduction in shoreline recession, and an improved capacity for desirable community growth. The future short-term uses of the project area are expected to be similar to current seasonal residential and recreational utilization. The reduction of harbor-induced erosion will not narrow the range of beneficial uses of the area. In fact, residential and recreational usage will directly benefit from the shoreline stabilization expected from the proposed project.

7.02 Existing shoreline residential areas will become increasingly more popular over the long-term, as the population continues to increase and emphasize leisurely life-styles. Enlightened maintenance of Lake Huron's shoreline and associated riparian tracts, if accomplished now, will result in an improved environment for future generations. Presently, larger trees and other vegetation are falling into the Lake, private property and structures are being threatened, and shoreline residents are suffering undue concern and financial burdens. This condition will be improved as a result of the project.

8. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

8.01 The irretrievable use of resources for the proposed action include the commitment of time, manpower, money, petroleum-based fuels, and groin and beach fill construction materials such as rock and gravel.

8.02 The petroleum-based fuels to be utilized in the construction phase of the proposed action constitute an irreversible commitment of limited hydrocarbon resources. Likewise, the time, manpower, and money required for the project are limited resources that, once committed, will not be retrievable. Natural resources that will be irreversibly committed if the project is implemented include about 300 cubic yards (230 cu m) of rock groin material and about 3,000 cubic yards (2,300 cu m) of beach fill material. Cultural resources such as archaeological and historical sites will not be committed.

8.03 About 3,000 square feet (280 sq m) of natural benthic habitat at the site of groin construction will be permanently lost. Fill placement will change the character of the nearshore benthic region covering about 37,000 square feet (3,400 sq m) for some time; however, recovery to a natural state will occur. Riparian tracts and associated lands, although affected by the proposed project, will not be irreversibly committed to any specific land use.

9. COORDINATION, COMMENTS AND RESPONSE

Coordination with the Public and Other Agencies

9.01 Public Participation. The objective of public involvement in Section 111 studies is to insure that these studies respond to public needs and preferences to the maximum extent possible, within the bounds of local, state, and federal programs. In the course of preparing this environmental statement, various people familiar with the environmental setting at Hammond Bay were contacted; most were officials of local and state government agencies.

9.02 A public workshop was held in Rogers City on September 16, 1976, for the purpose of providing information and clarification of policy concerning Section 111 studies at Hammond Bay. Discussions included details of the Section 111 studies authority, the planning process, the erosion damage quantification procedure, and of the methodology of impact assessment. The workshop also provided the public and all interested parties with an opportunity to express their viewpoints, ask questions, and raise issues bearing on the erosion problem. Approximately 15 persons attended the workshop and a great deal of information was exchanged. One letter of comment was subsequently received, and that letter and the Corps' reply are shown on pages B-27 through B-30 in Appendix B.

9.03 Government Agency Coordination. Several local government agencies were contacted and consulted regarding the erosion problem and environmental setting near Hammond Bay Refuge Harbor. The Presque Isle County Road Commission Office supplied information on U.S. Route 23 and present threats from erosion. The County Equalization Department, Register of Deeds,

and the County Recorder provided information on land ownership and present worth in the vicinity of the harbor. The County Building and Zoning Commission was contacted for information on current land usage and building regulations for the affected area. The County Clerk and the Presque Isle County Historical Museum furnished detailed maps and historical information on Rogers City and Presque Isle County.

9.04 State agencies were consulted on a variety of subjects. Michigan's Department of Natural Resources (DNR) supplied invaluable information on fish and fishery activities in the vicinity of the harbor. The time of year for project implementation was designated based on DNR Fisheries Division information, and will minimize adverse impacts to local fish populations. Michigan's History Division, the State Historic Preservation Officer, and the State Archaeologist were consulted regarding potential impacts to cultural, archaeological or historical factors resulting from the project. The State Department of Agriculture supplied detailed climate data for the study area.

9.05 Several federal agencies supplied basic information without which the study could not have been accomplished. Detailed aerial photographs were supplied by the EROS Data Center and the Department of Agriculture, ASCS. The National Oceanic and Atmospheric Administration supplied climate data and information on fish species of Lake Huron. The Environmental Protection Agency furnished data on air and sediment quality for Hammond Bay Harbor and vicinity. The Great Lakes Fisheries Laboratory of the Fish and Wildlife Service provided detailed information on local ecology and

water quality for the area. The National Park Service (Keeper of the National Register) and the Advisory Council on Historic Preservation were consulted about potential impacts to historic and cultural resources in the vicinity of proposed construction. Copies of relevant correspondence are presented in Appendix B.

9.06 Other pertinent data and information were also collected from the Fish and Wildlife Service, various agencies in the City of Lansing, and from the University of Michigan. Consultations were held with representatives of the Coastal Engineering Research Center, Corps of Engineers, concerning erosion problems of the area.

Environmental Statement Deliveries

9.07 Agencies and Officials. Copies of the Draft Environmental Impact Statement were sent to the United States Senators and Representatives, the State Governor, concerned Federal and State agencies and local governments, interested private organizations, and concerned citizens. The Draft Statement was also mailed in response to all requests. The addresses of the requesting citizens or agencies were noted and these interested parties also received a copy of the Final Environmental Statement.

9.08 The Draft and Final Environmental Statements have been sent to the following agencies and officials:

Advisory Council on Historic Preservation

Bearinger Township

Federal Power Commission

Great Lakes Area National Park Service

Great Lakes Basin Commission

Michigan Area Council of Governments

Michigan Department of Agriculture/Weather Service

Michigan Department of Commerce

Michigan Department of Natural Resources

Michigan Department of Public Health

Michigan Department of State Highways and Transportation

Michigan Historical Commission
- -Office of the Planning Coordinator

National Marine Fisheries

Presque Isle County
- -Building and Zoning Commission
- -Equalization Department
- -Historical Museum
- -Road Commission Office

State of Michigan, State Archaeologist

State of Michigan, State Conservationist

State of Michigan, State Historic Preservation Coordinator

U.S. Department of Agriculture
- -Forest Service
- -Soil Conservation Service

U.S. Department of Commerce
- -National Marine Fisheries Service
- -National Oceanic & Atmospheric Administration

U.S. Department of Health, Education & Welfare

U.S. Department of Housing & Urban Development

U.S. Department of the Interior
- -Bureau of Outdoor Recreation
- -Fish and Wildlife Service
- -Fish and Wildlife Survey, Great Lakes Fisheries Laboratory
- -U.S. Geological Survey

U.S. Department of the Interior (National Park Service for Investigations of Historical, Archaeological, and Paleontological Resources)

U.S. Department of Transportation
-Federal Highway Administration
-U.S. Coast Guard

U.S. Environmental Protection Agency

Water Resources Council

'.09 Citizen Groups. The Draft and Final Environmental Statements have also been sent to the following groups:

Advisory Council for Environmental Quality

Federated Garden Club of Michigan

Michigan Audubon Society

Michigan Parks Association

Michigan Unified Conservation Clubs

National Resources Defense Council

Presque Isle County Chamber of Commerce

Sierra Club, Huron Valley Group

Sierra Club, Midwest Representative

West Michigan Environmental Actions Council

West Michigan Shoreline Protection Association

'omments and Response

'.10 The following comment/response section addresses pertinent comments and suggestions submitted by interested agencies, groups, and citizens. In total, 14 replies to the Draft Environmental Statement were received. Copies of these replies are presented in Appendix C.

'EDERAL AGENCIES

Advisory Council on Historic Preservation

1. Comment: Pursuant to our responsibilities under ection 102(2)(C) of the National Environmental Policy Act of 969 and the Council's "Procedures for the Protection of Historic nd Cultural Properties" (36 C.F.R.; Part 800), we have determined that your draft environmental statement appears adequate concerning our area of interest, and we have no further comments to make.

U.S. Department of Agriculture - Soil Conservation Service

1. Comment: We have reviewed the draft environmental statement and do not have any comments.

U.S. Department of Commerce - The Assistant Secretary for Science and Technology

1. Comment: The enclosed comments from the National Oceanic and Atmospheric Administration (NOAA) are forwarded for your consideration.

U.S. Department of Commerce - NOAA, Environmental Data Service (EDS)

1. Comment: Storm winds play an important role in shore erosion. The environmental statement states (p. 53) that the "direction, magnitude, and duration of Lake Huron storms have considerable influence on shore erosion." The climate discussion,

however, fails to give information on winds and storms in the project area. The environmental statement would be enhanced if data on storm direction, magnitude, and duration were included, as well as information on the direction and strength of associated storm winds.

Climatological data are available from the National Climatic Center, Asheville, North Carolina, 28801.

Response: As indicated in the climate section, prevailing winds at Hammond Bay are from the northwest and blow predominantly in the offshore direction. Net wind transport of sands is therefore into the drift zone. Moreover, because of the abundant vegetative cover and dominance of large sediment particles on the beach, the amount of wind transport is slight. At Hammond Bay, wave and current forces are the prime cause of erosion. Localized storms, of course, are one of the generators of these forces, and paragraph 2.08 has been expanded to reflect the occurrence and frequency of these phenomena in the area. Distant storms (i.e., storms remote from the area) also play an important role in the generation of these forces at Hammond Bay. In determining erosion, however, factors of relevant importance are the site-specific hydraulic energy statistics as affected by all generators. Reference is made to the U.S. ARMY CORPS OF ENGINEERS SECTION 111 DETAILED PROJECT REPORT (DPR) ON SHORE DAMAGE AT HAMMOND BAY HARBOR, MICHIGAN for a thorough presentation of these data. The conclusion of this report was that the southerly component of prevailing hydraulic energy results in the transport of littoral materials into the harbor, and that the presence of the navigation structures negates transport out of the harbor, regardless of the direction and source of the energy-inducing forces.

U.S. Department of Commerce - NOAA, Environmental Research Laboratories

1. Comment: Placement of a rock groin supplemented by a beach fill appears to be an inexpensive way to mitigate shore damage caused by the harbor structures.

Analysis of ongoing shore processes in the Hammond Bay area neglects the role of currents. In the vicinity of Hammond Bay, the most effective waves are from easterly directions due to the longest fetch. Littoral currents generated by easterly winds are from the south to the north. In the bay, however, an anti-clockwise eddy current exists which sweeps the shore and moves the eroded sediment from north to south towards the harbor structures. Construction of the groin will deflect part of the current from the shore and will shift the location of the eddy slightly to the north. For this reason, potential of the erosion will be shifted north and, depending on the effectiveness of present shore protection structures, it may or may not develop erosion. A small clockwise eddy will form on the south side of the proposed groin causing minor erosion just south of the groin.

The main purpose of the beach fill is fast restoration of eroded sand beach. It will not diminish the erosion potential further north. Shoreline erosion at any particular location is a complex phenomenon; however, in most cases, it does not depend on location of deposition. Therefore, assumption is not correct that without the proposed beach fill the shoreline north of the proposed groin would erode to the extent of providing enough material to fill the groin through natural processes (paragraph 4.35). It appears that erosion north of the proposed beach fill will remain the same with or without the fill and, as stated above,

will depend mainly on the efficiency of existing protection structures.

Response: Approximately 1,200 feet north of Hammond Bay Harbor, there presently exists a shore protection structure that was privately constructed. Since its placement, it has operated much like a short groin. Moreover, there is visual evidence that this structure has served to mitigate erosion damage along a short stretch of the beach to the immediate north. South of this structure, however, erosion has continued. The proposed plan deals with the placement of a more substantial groin near the point where the first signs of erosion occur north of the harbor. It is felt that a properly designed groin at this point would, like the existing structure, substantially reduce erosion to the north, but would have more far reaching mitigative effects. There is admittedly some risk concerning the possibility of newly induced erosion to the immediate south. Sediments between the navigation structures and the new groin will likely undergo some redistribution, the end result being some new stabilized state. Further changes beyond this redistribution are not expected.

Recent visits to Hammond Bay Harbor visually attest to the natural buildup of a sand fillet immediately north of the aforementioned privately constructed shore protective structure. Hence, if no artificial fill were provided as planned, erosion to the north of the new groin would surely continue until a stabilized fillet had evolved. Thus, the statement in paragraph 4.35 to that effect would appear to be correct.

U.S. Department of Health, Education, and Welfare

1. Comment: We have reviewed the Draft Environmental Impact Statement for the above project. To our knowledge, and based upon the information provided, this project will not impact to any significant degree on the health, education or welfare of the population.

U.S. Department of the Interior

1. Comment: We have reviewed the document and conclude that it adequately considers those areas within our jurisdiction and expertise. We offer the following comment and suggestion for your consideration.

2. Comment: Additional information could be provided to better describe the fish species found in the immediate vicinity of the proposed work area. For instance, Table 12, page 68 implies that all fish species listed were recorded in the vicinity of Hammond Bay Harbor. This list, which was compiled by the Michigan Water Resources Commission, includes "Representative Important Species" from large geographical zones. In this case, Hammond Bay Harbor would be within geographical zone 2 as described in the Commission's list. Zone 2 includes northern Lake Michigan as well as northern Lake Huron. Some species in the list may not be found in the immediate work area planned for the harbor. Atlantic salmon, brook trout and sauger, for example, are not found commonly in the area as listed and should be removed from the list. Specific sampling of fish species at the site would provide the most accurate list of species likely to be impacted by groin construction.

Response: Atlantic salmon, brook trout, and sauger have been removed from the list in Table 12. Also, the scientific name for rainbow smelt was in error and has been corrected. A footnote has been added to the table to reflect the fact that the Michigan Water Resource Commission listing has been modified as per your suggestion. Regarding the suggestion for specific sampling of fish species, reference is made to a copy of the correspondence received from the Michigan Department of Natural Resources (DNR) concerning Hammond Bay fisheries (see Appendix B, page b-25). It is to be noted that, prior to the implementation of the proposed action, the U.S. Corps of Engineers will consult with the Michigan DNR, U.S. Fish and Wildlife Service, and other concerned agencies and officials regarding this matter.

U.S. Department of Transportation - Federal Highway Administration

1. Comment: The draft EIS for the mitigation of shore damage attributed to the Federal navigation structures at Hammond Bay Harbor, Michigan has been reviewed and we have no comments regarding the improvement. The statement adequately addresses the possible effects this improvement may have on US-23, a Federal-aid route.

U.S. Department of Transportation - United States Coast Guard

1. Comment: The Draft Environmental Impact Statement, referenced above, has been reviewed by this office and at this time we offer no comments.

U.S. Environmental Protection Agency - Region V

1. Comment: In general, we have no major objections to he proposed action and believe the EIS is adequate. We offer he following comments for your consideration.

2. Comment: It would be helpful to indicate in the Final IS the extent that high lake levels have contributed to the ncreased erosion north of the harbor and their affect on the outherly drift component.

Response: If it were not for the occurrence of high ake levels in Lake Huron over the past several years, erosion orth of Hammond Bay Harbor would have been minimal. The lower horeline levels are predominantly characterized by cobbles, ravel-sized rock, and hardpan clay--all of which are moderate esistant to the erosive forces typically prevailing in the a rodable sand materials, on the other hand, predominate at the igher shoreline levels. Though well covered with vegetation and therefore less subject to wind transport, these sand materials are not invulnerable to wave attack. The primary ingredient is for the lake level to be sufficiently high enough for wave runup to reach these sands, thereby rendering the materials as candidates to become part of the littoral stream. Such being the case, and if the navigation structures were not present, sand movement to and from the shore would be balanced, and long term net erosion would be unlikely. But the presence of the harbor interferes with this balance by restricting, during times of northerly drift, the sand supply needed by the shoreline to the immediate north. Thus, high lake levels at Hammond Bay contribute to littoral drift and make shoreline erosion

massuredly possible. Erosion becomes certain, however, with he presence of the harbor structures.

3. Comment: We have classified our comments on the project as LO (lack of objection) and on the EIS as category 1 (adequate). The date and classification of our comments wil. be published in the Federal Register in accordance with our agency's responsibility to review other Agencies' projects.

We appreciate the opportunity to review such a well-prepared draft EIS.

STATE AGENCIES

Michigan Department of Natural Resources

1. Comment: We have reviewed the draft environmental statement for the proposed mitigation of shore damage at Hammond Bay Harbor. We find the statement generally acceptable in scope and content.

2. Comment: The attached analysis prepared by our Office of Program Review and Project Clearance represents the Department's views on this proposal. We feel the long term effects of the placement of a groin and fill may have eventual effects on the shoreline to the north which lies between this site and Pond Point. These possible effects should be evaluated in more detail. The remainder of the comments deal with considerations of public access, revegetation and corrections in the text.

The environmental statement, for the most part, adequately and comprehensively describes the mitigation project and associated impacts. However, there are portions of the document which need additional information and corrections.

We do not feel that the statement thoroughly assesses the possible impact of the groin on shoreline problems just north of the groin and fill site. It is indicated that erosion will be abated along 1,500 feet of shoreline subject to erosion north of the groin placement (page 91, 4.20). It is not clear from the information provided that the proposed groin and fill will not eventually transfer the more critical shoreline erosion

problems to that area between the groin and Pond Point. This possibility should be more extensively examined in the final statement. Since there is a possiblility that the groin and fill may bring only short term relief from erosion problems, effects on existing groins in similar situations along the Great Lakes shores should be evaluated and reported in the statement.

Response: Reference is made to the U.S. ARMY CORPS OF ENGINEERS SECTION 111 DETAILED PROJECT REPORT (DPR) ON SHORE DAMAGE AT HAMMOND BAY HARBOR, MICHIGAN for the analysis which led to the selection of the proposed plan addressed herein. The analysis indicates that current shoreline erosion between Pond Point and the intended site for the groin will be abated if the proposed plan is implemented. Expected effects in this reach are elaborated upon in paragraph 4.33 through 4.43 of this document. Additional discussion is also provided in the response to Comment #1 of the U.S. Department of Commerce - NOAA, Environmental Research Laboratories. It is to be noted that the designated length (i.e., 1,500 feet) of the subject shoreline stretch was in error in the Draft Statement and has been changed to 1,800 feet.

3. Comment: page 11, paragraph 2--Is the access property now in public ownership, or can it become publically owned to provide limited fishing access?

Response: This question is addressed in Appendix B, pages B-27 through B-30.

4. Comment: Page 11, paragraph 3--The clean up should include mulching and revegetation with plant materials which will provide a matted root (such as willows or red osier dogwood) to protect further erosion.

Response: Paragraph 3 has been revised to reflect this suggested recommendation. Also, paragraph 4.27 on page 34 has been similarly revised. Prior to implementing the proposed plan, decisions as to the necessity of replanting the access road areas with certain plant species will be made in consultation with the Michigan Department of Natural Resources and any other interested agencies or officials.

5. Comment: Page 14, Section 1.19--Some mention should be made of the negative aesthetic impact of the groin. It is not likely that the beauty of a groin will replace the natural beach beauty which existed prior to 1963.

Response: Aesthetic impacts associated with the presence of the groin and fill are discussed in paragraph 4.40 on page 97.

6. Comment: Atlantic salmon (Salmo salar) is not a common species. It was introduced into Lake Huron, but is no longer being stocked there.

Rainbow smelt (Osmerus esperlantus) should be corrected to read (Osmerus mordax).

We would also suggest that the subspecies listing of "vitreum" and "griseum", respectively on walleye and sauger be dropped. Also, sauger is not common in Lake Michigan.

Response: Revisions have been made to Table 12 in accordance with your comment as well as with Comment #2 put forth by the U.S. Department of the Interior.

7. Comment: Page 69, Section 2.86--It is indicated in this paragraph that rainbow trout make upstream runs in September and October and, after spawning, return downstream in May and June. Actually, Michigan rainbow trout are primarily spring spawners, running upstream April through early May to spawn. It should be noted, however, that some fish do make fall runs.

Response: Paragraph 2.86 has been revised to reflect the suggested clarification.

8. Comment: Page 75, Section 2.92--The fifth sentence should read "Lake Huron's", rather than "Lake Michigan's", sport fisheries. Also, in the last sentence on that page, after 1967, add "and lake trout in the early 70's".

Response: Paragraph 2.92 has been revised according

9. Comment: Page 85, Section 4.04--In this paragraph, such factors as commercial and industrial [illegible], desirable regional growth, community cohesion, etc., are listed as environmental factors. These are not environmental factors, but rather, economical factors.

Response: The factors referred to in the last sentence of paragraph 4.04 are a mixture attributes which fall into either socioeconomic or cultural resource categories. Both categories are part of the human [illegible]. In the words

Congress as directed by Section 102 (C) of the National Environmental Policy Act:

> "...all agencies of the Federal Government shall include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment (emphasis added), a detailed statement by the responsible official on (i) the environmental impact of the proposed action,..."

In context, therefore, the human environment must include the physical, chemical, biological, socioeconomic and cultural categories. The attributes of these categories are thus environmental factors.

10. Comment: Page 87, Section 4.09--Relative to grains, it is stated in this paragraph that the smothered benthic habitat is a very small portion of the existing benthic habitat and the adverse impact is expected to be insignificant. This may or may not be true of the large scale habitat; however it could be quite significant on the local basis. Further, in the last sentence of this paragraph, it is stated that where gravels and cobbles are subjected to the effect of waves it is conspicuously devoid of animals. This is wrong. Such areas are normally quite rich in aquatic [illegible].

Response: Paragraph 4.09 has been revised accordingly.

11. Comment: Page 92, Section 4.13--It is again mentioned in this paragraph that the wave-washed and gravel-strewn section of the littoral zone is characteristically devoid of organisms. As previously mentioned, this is incorrect.

Response: Paragraph 4.23 has been appropriately revised.

12. Comment: Page 93, Section 4.26--The last sentence should be rewritten to read, "Any adverse impacts, should they occur, would most likely be of low magnitude and not of significant degree to harm the local fauna".

Response: The last sentence of paragraph 4.26 has been rewritten as suggested.

13. Comment: Page 119, Section 6.12--This paragraph should specify the type of aquatic organisms which could be lost as the result of this operation.

Response: Beach organisms such as amphipods, worms, insect larvae, and perhaps molluscs are the types of organisms that would be lost as a result of heavy equipment operation and material placement activities associated with the alternative of establishing protective beaches. This information has been incorporated into paragraph 6.12.

Michigan Department of State Highways and Transportation

1. Comment: A biological inventory of the [illegible] should be included. Small special environments are scattered along Michigan beaches. Many have been identified and described in articles and papers. Others are known by local experts. However, no complete inventory has ever been made [illegible]. Therefore, unless references are available [illegible] affected site, the reader has no basis [illegible] of the communities present without inventory.

Response: Two general field reconnaisance surveys by qualified biologists from the staff of the consultant were performed in the winter and summer of 1976. No special or extraordinary species distributional patterns were noted. The environmental setting was similiar to the shoreline areas for at least a mile either way along the coast from the harbor. A literature search did not reveal any pertinent reports describing this area as unique, such as seen in the ecological inventory report on pages B-22A thru B-22C.

2. Comment: US-23 is only about 150 feet from the impacted area. Discussion of adverse impacts due to the use of trucks and other heavy equipment during construction should include the negative impact on the condition of the highway and the resulting increased maintenance cost to Michigan taxpayers.

Response: Paragraphs 4.12 and 4.28 on pages 88 and 94, respectively, have been appropriately expanded to include the suggested discussion. Moreover, ratings have been added to the impact matrix (Table 17, "Structures" row of columns 1 and 2), thus adding to the summary right-hand and bottom totals.

3. Comment: Concentration of trucks and construction equipment on a Michigan trunkline may reduce motorist safety. This problem should be addressed.

Response: The impact associated with motorist safety is addressed in paragraphs 4.13 and 4.29 of the report under fill construction activities, respectively.

4. Comment: No reference is made to the possibility that the results of this action may protect US-23 against future undermining, due to shoreline erosion. If this possibility exists, it should be included as a positive impact.

Response: Paragraph 4.43 has been slightly modified to reflect this positive impact.

5. Comment: Total destroyed terrestrial vegetation and benthic habitat is commendably small. The total additional area receiving observable environmental impacts should also be estimated.

Response: Other than the shoreline area determined by the zone of adverse influence (discussed in Section D), no other additional area is expected to receive observable environmental impacts.

6. Comment: ii. - 2.1 It would be more appropriate to state that 47 potential impacts have been identified, since classification of impacts varies among investigators, and as there may be unidentified impacts involved, since no specific number is given, they should be listed.

Response: The first sentence of this paragraph has been changed as suggested.

7. Comment: pp. 17 of the Environmental Setting Without the Project is rather lengthy considering the scope of the project. Perhaps part of the material could be incorporated into an appendix.

Response: The content of each Section of this Statement is but one of several ways in which required information might have been presented. Incorporating part of the Section 2 material into an appendix would have been another way of accomplishing the same. In either case, the spirit and intent of the Statement would be identical. Hence, to do as suggested would not be a cost-effective measure.

8. Comment: This section contains numerous technical errors, some of which we have repeatedly identified in previous U.S. Army Corps of Engineer Impact Statements prepared by Tetra Tech, Incorporated, but which continue to appear. An example of such an error is the appearance in Table 15 of "Long-necked Pheasant" rather than "Ring-necked Pheasant." We suggest that Tetra Tech, Incorporated correct its files as it revises the Environmental Statement.

Response: The Long-necked Pheasant (Phasianus torquatus) has been deleted from Table 15 and replaced with the Ring-necked Pheasant (Phasianus colchicus).

9. Comment: Some of the tables are inaccurate, or at least have misleading titles. For example, Table 10 "Indigenous Tree Species of Michigan" lists only 30 species. Table 11 "Plant Species Recorded for the Northern Portion of Michigan's Lower Peninsula" also lists only 30 species, all beach plants. These should have titles revised to reflect what the lists actually represent.

Response: As noted in paragraph [illegible], many of the species are indigenous to Michigan, [illegible] of these are [illegible]

n Table 10. Also, paragraph 2.76 states that the listing in Table 11 is a partial listing only. Hence, the word "Selected" has been introduced into the title of each table.

10. Comment: pp. 103 - 115 Table 18 was of very little use in evaluating the project. It should be remodeled or removed.

Response: Table 18 is intended to provide a comparative summary of the significant impacts associated with proposed project and each considered alternative. An alternatives display of impacts is a requirement of Principles and Standards for Water and Related Land Resources by the Water Resources Council.

CITIZENS

Mr. and Mrs. Joseph Muser

1. Comment: We have read the environmental impact study in regard to the shoreline protective works which the Corps of Engineers is proposing to build on Hammond Bay, as indicated in the project study we have sufferred considerable damage to our property due to erosion since the refuge Harbor was built and have had to spend a large amount of money so that we wouldn't completly lose our property.

2. Comment: It appears to us that the proposed construction of the wall will cause further erosion to our property unless the shoreline is strengthened and the wall is extended further in the lake.

Response: Construction of a groin and the placement of 3,000 cubic yards of fill as per Figure 2 will not cause further erosion to the north. Rather, the groin will impede the passage of littoral material from the northerly shoreline to the harbor where it would likely remain trapped. The beach fill will eliminate any accretion demand which the groin by itself would have for northerly shoreline material. Hence, the combination of groin and fill would result in protection to that part of the shoreline defined in Plate 1 as the zone of adverse influence. Further strengthening of the shoreline should not be necessary,nor should there be any need to extend the proposed groin wall beyond the planned 150 feet.

3. Comment: secondly the construction of the wall will ndoubtly interfere with the normal use of our cottage and ay cause damage since we have the nearest building and have ad the most damage trees - wall - etcetera.

Response: Implementation of the proposed plan is nticipated to require about one month of shoreline construction ork. Moreover, it is expected that this work will be a one-ime-only activity. The expected impacts associated with groin onstruction and beach fill placement have been discussed in ome detail on pages 86-90 and 90-95, respectively. As noted, he activity will temporarily interfere with certain coastline ecreational pastimes such as beach strolling, bathing, and erhaps fishing. Construction traffic and noises will likely e of some disturbance to those close by, and the aesthetic eauty of the area will be temporarily degraded. However, hese construction activities will ultimately lead to mitigation f ongoing shoreline erosion north of the proposed groin. Of ourse, residents in this area will be the ones to substantially enefit from this result. Temporarily localized disturbances uch as those mentioned above would,therefore,appear to be orth the trade.

Alex Kress

1. Comment: I have thoroughly read thru the comprehensive and enlightening Environmental Statement, issued by your Corps, on the Mitigation at the Hammond Bay Refuge Harbor. As a professional engineer, I am in complete accord with the proposals contained in your report to mitigate the damage already sustained, to prevent additional damages from occuring to the shoreline in the subject area.

As shown in your report, we have, as individuals, done all that we can to protect our shoreline from further erosion. However, if we do not receive the aid, as outlined in your Statement, we fear what the elements may wreak, in time to come. Our wooden plank seawall could very conceivably be destroyed. It has been installed at a considerable personal expenditure of funds.

I would like to go on record, at the meeting being held this coming Thursday, as being 100% in favor of the Corps recommendations outlined in their Statement.

Response: Your review and comments are sincerely appreciated.

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GLOSSARY

accretion - natural accretion is the gradual build-up of land over a long period of time solely by the action of the forces of nature, on a BEACH by deposition of water- or air-borne material. Artificial accretion is a similar build-up of land by reason of an act of man, such as the accretion formed by a groin, breakwater, or beach fill deposited by mechanical means.

agriculture and undeveloped lands - this type of shoreland use includes croplands, pasturelands, and all vacant and undeveloped lands except forests and wooded areas.

algae - primitive aquatic plants, either one- or multi-celled, capable of photosynthesis. These plants are a source of food for the higher forms of life and, like all plants, put oxygen into the water.

alluvial deposit - sediment (sand, silt or detrital material) deposited in place by the action of streams.

artificial nourishment - the process of rebuilding a beach by the replenishment of beach materials by artificial means such as the deposition of dredge spoil.

artificial beach - an area of the shoreland that has been artificially modified by man through the placement of structures, by filling, or by dredging so that the original natural shoreline no longer exists.

backshore - that zone of the shore or beach that lies landward of the foreshore which is usually dry and only affected by wave action generated by severe storms.

beach - a shoreland zone of unconsolidated material that extends landward from the shoreline to the place where there is a marked change in material or physiographic form or to the line of permanent vegetation. The lakeward limit of a beach includes the foreshore and backshore.

beach erosion - the carrying away of beach materials by wave action, tidal currents, or littoral currents, or by winds.

beach width - the horizontal dimension of the beach as measured normal to the shoreline.

benthos - the group of organisms which comprise the aquatic bottom community.

biota - animal and plant life of a stream or other water body.

bluff - a high, steep bank of cliff, especially beside a body of water.

BOD - an abbreviation for biochemical oxygen demand which is the quantity of oxygen consumed in the biochemical oxidation of organic matter in a specific time, at a specified temperature.

breakwater - a structure for breaking the force of waves to protect craft anchored in a harbor or to protect a beach from erosion. An offshore barrier may be either an artificial structure or a natural formation. Sometimes it is connected at one, or both, ends with the shore.

coastal area - the land and sea area bordering the shoreline.

coast line - (1) technically, the line that forms the boundary between the coast and the shore; (2) commonly, the line that forms the boundary between the land and the water.

COD - an abbreviation for chemical oxygen demand. This term is a measure of oxygen consuming capacity of organic and inorganic matter present in water or wastewater.

coliform - a group of bacteria which includes all aerobic and facultative anaerobic gram-negative bacilli that ferment lactose with the production of gas.

commercial - this type of shoreland use generally includes buildings, parking areas and other lands directly related to retail and wholesale trade and business and professional services. Examples of commercial land uses are stores, gas stations, motels, marinas, professional buildings, and restaurants.

contour - (1) a line connecting the points, on a land or submarine surface, that have the same elevation; (2) in topographic or hydrographic work, a line connecting all points of equal elevation above or below a datum plane.

conventional pollutants - phenols, phosphorous, nitrogen, iron, oil and grease, solids and heavy metals other than mercury.

current, coastal - one of the offshore currents flowing generally parallel to the shore line with a relatively uniform velocity (as compared to the littoral currents). They are not related genetically to distribution of mass in lake waters (or local eddies), and wind-driven currents.

current, littoral - the nearshore currents primarily due to wave action, e.g., Longshore currents and Rip currents.

downdrift - the predominant direction of movement of littoral materials.

dredge spoil - material removed from the bottom of a lake or river by a process known as dredging.

drift - (1) the speed at which a current runs; (2) also, floating material deposited on a beach (driftwood); (3) a deposit of a continental ice sheet, as a drumlin; (4) sometimes used as an abbreviation of littoral drift.

dunes - ridges, mounds or hills of loose, windblown material, usually sand. Stable dunes are those which are covered with vegetation and generally not readily susceptible to erosion by wind or water runoff. Unstable dunes are those which are bare of vegetation and subject to movement or erosion by both wind and water.

ecology - the study of organisms in relation to their environment.

environmental areas - areas of the shorelands both upland and offshore, which provide habitat for fish, wildlife and other aquatic life, contain unique populations of flora and fauna, or are otherwise ecologically significant.

environmental impact - a word used to express the extent or severity of an environmental effect.

erosion - the wearing away of the land by the action of wind, water, gravity or a combination thereof. Shoreland erosion on the Great Lakes is most often a result of a combination of (a) wind driving waves beating upon the shore and forming littoral currents, and (b) high water levels.

fecal coliform - portion of the coliform group present in the feces of warm-blooded animals, which produces gas from lactose at 44.5°C.

feeder beach - an artificial beach formed by the deposition of imported sediments on the shoreline for the purpose of supplying materials into the littoral stream.

foreshore - that zone of the shore or beach lying landward of the shoreline which is usually wet and directly affected by all wave action.

forest - an association dominated by trees; usually [illegible] as woody plants over 10 meters in height.

reeboard - the additional height of a structure above design high water level to prevent overflow. Also, at a given time the vertical distance between the water level and the top of the structure. On a ship, the distance from the water line to main deck or gunwale.

abion - a specifically designed basket or box of corrosion resistant wire used to hold rock and other coarse aggregate. Gabions may be locked together to form groins, seawalls, revetments, deflectors, breakwaters and other protective structures for erosion control. Their flexible construction permits minor adjustments of alignment resulting from undercutting, filling and settling.

eomorphology - that branch of both physiography and geology which deals with the form of the earth, the general configuration of its surface, and the changes that take place in the evolution of land forms.

reat Lakes Region - the boundary of the Great Lakes Basin defined by selected county lines for statistical data availability and economic analysis.

groin - a shore protective structure (built usually perpendicular to the shoreline) to trap littoral drift or retard erosion of the shore. It is narrow in width and its length may vary from less than one hundred to several hundred feet (extending from a point landward of the shoreline out into the water). Groins may be classified permeable or impermeable and may be manufactured of wood,

concrete or steel. Impermeable groins have a solid or nearly solid structure. Permeable groins contain openings of sufficient size to permit passage of large quantitites of littoral drift.

groundwater - water in the pores and crevices of the earth's mantle rock which has entered it as rain percolating down from the ground surface.

harbor - an area of water along the shoreline which affords shelter to commercial and recreational water craft. It may have been formed naturally or artificially, or by the artificial improvement of a natural shore feature. Harbors may be classified as commercial harbors or harbors-of-refuge. Commercial harbors are deep-draft harbors designed primarily for overseas or domestic vessels engaged in waterborne commerce. Harbors-of-refuge are small harbors along the shores of the Great Lakes located between commercial harbors and designed mainly to be a place of refuge for small recreational craft during storms.

high water line - in strictness, the intersection of the plane of mean high water with the shore. The shoreline delineated on the nautical charts of the Coast and Geodetic Survey is an approximation of the mean high waterline.

hopper dredge - a vessel equipped with two drag and suction pipes to "vacuum" the water floor and with hopper bins to store the dredged material which will finally be pumped into a disposal area.

impact matrix - an array of numerical values in prescribed form which quantify the impact of the action aspects (columns) upon certain environmental factors (rows).

industrial - this type of land use includes all industrial buildings, parking areas, adjacent yards and landscaped grounds. Included are warehousing, mining and other extractive industries, manufacturing industries, steel mills, private utilities and railroad facilities.

jetty - this term is used synonymously with groins on ocean sea coasts and are designed to prevent shoaling by littoral materials in channels. They are often constructed at the mouth of a river or tidal inlet to help deepen and stabilize the channel.

levee - a dike or embankment for the protection of land from inundation.

littoral - pertains to the shore, either or both the shoreland and shore waters and nearshore bottom of a lake.

littoral deposits - deposits of littoral drift.

littoral drift - the bottom materials moved in the littoral zone under the influence of waves and current. Direction of movement or "transport" of littoral materials depends upon wind and wave direction.

littoral transport - the movement of material along the shore in the littoral zone by waves and currents.

low water datum - an approximation to the plane of mean low water that has been adopted as a standard reference plane.

marsh - a tract of soft, wet or periodically inundated land, generally treeless and usually characterized by grasses and other low growth.

monitoring program - an investigation before, during and after a project to study effects.

mooring facility - a place where a ship is fastened.

nodal-zone - an area at which the predominant direction of the littoral transport changes.

non-structural measures - the management, utilization or control of water and related shorelands without structural development to achieve a desired goal or objective. Recommendations for non-structural measures for the shorelands of the Great Lakes in this study will often apply most reasonably to undeveloped portions of the shorelands.

offshore - in beach terminology, the comparatively flat zone of variable width, extending from the breaker zone to the seaward edge of the continental shelf.

pier - a structure extending out into the water from the shore to serve as a landing place, a recreational facility or to form a channel rather than afford shoreland protection.

pile - a long, slender piece of wood, concrete, or metal to be driven or jetted into the earth or sea bed to serve as a support or protection.

pile, sheet - a pile with a generally flat cross-section to be driven into the ground or sea bed and meshed or interlocked with like members to form a diaphragm, wall, or bulkhead.

plain - a low-lying, relatively flat shoreland which extends several hundred feet landward from the shoreline.

plankton - drifting organisms, usually microscopic, floating or weakly swimming in a body of water.

pollutant - matter in the environment that exceeds established levels of tolerance set by man for his health, comfort and well-being.

profile, beach - the intersection of the ground surface with a vertical plane; may extend from the top of the dune line to the seaward limit of sand movement.

public buildings and related lands - this shoreland use includes all buildings and related grounds belonging to public or quasipublic agencies, governments, or organizations. This would encompass medical facilities, educational facilities, religious institutions, governmental administration and service buildings, military installations, water and sewage treatment plants, and airports.

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MITIGATION OF SHORE DAMAGE ATTRIBUTED TO THE FEDERAL NAVIGATION--ETC(U)
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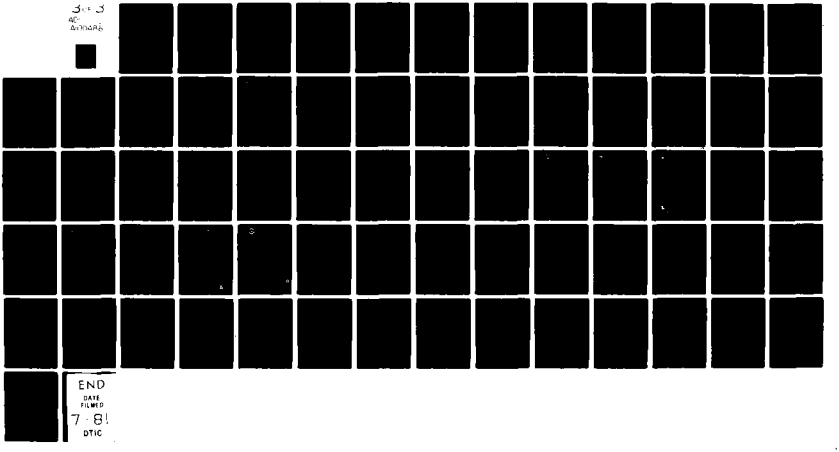

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pumpout station - a temporary dock where a connection is made between land and dredge pipes; a booster pump may be used.

recreation and other urban public use space - this shoreland use contains all designated public outdoor recreation lands and associated facilities. Privately owned outdoor recreation lands, such as golf courses, tennis clubs, amusement parks, and race tracks are included. Cemetaries have been placed in this category as well.

residential - residential shoreland use has been defined to include four or more single or multi-family dwelling units adjacent to each other. Also included within this category are churches, elementary schools, small neighborhood parks, and small isolated commercial buildings, such as a neighborhood grocery store, within the boundaries of the residential area.

revetment - a facing of stone, concrete, etc., built to protect a scarp, embankment, or shore structure against erosion by the wave action or currents.

riparian - one who owns land on the bank of a natural watercourse or body of water.

riparian right - the right of an owner of land bordering on a stream or lake to have access to, and use of, the shore and water. The use of this water is restricted to riparian landowners, and the right is automatic, not created by use nor forfeited through disuse.

riprap - a layer, facing, or protective mound of stones randomly placed to prevent erosion, scour, or sloughing of a structure or embankment; also the stone so used.

rubble-mound structure - a mound of random-shaped and random-placed stones protected with a cover layer of selected stones or specially shaped concrete armor units. (Armor units in primary cover layer may be placed in orderly manner or dumped at random).

run-up - the rush of water up a structure on the breaking of a wave. The amount of run-up is the vertical height above still water level that the rush of water reaches.

scientific nomenclature - scientific nomenclature of animals requires (1) that each species and genus found in the world shall have a name that is independent of change, such as pertains to common names used in many languages; (2) that each species and genus shall have separate names duplicated by none which refer to some other species or genus; and (3) that different names shall not be applicable to any one species or genus. The following is a breakdown of Categories of Higher Rank than Species and Genus:

Kingdom
Phylum
Class
Order
Family
Tribe
Genus
Species

Referencing the above, a glossary of fish families follows:

Family Acipenseridae - the sturgeon family, consisting of temperate water fishes in the northern hemisphere. Members of this family are of great commercial and sportfishing value.

Family Catostomidae - a family which is composed of small fish commonly called suckers. Members of this family are bottom feeders and are important food sources for larger fish.

Family Clupeidae - the herring family. Members of this family live in large lakes and sluggish areas of large rivers. Most feed on plankton. Fresh water species have little commercial value but play an important role in the diet of many gamefishes. The gizzard shad and the alewife are prominent Great Lakes species.

Family Cottidae - a family of fish consisting of sculpins and related forms. Most of the species of this family are marine, however, a few freshwater species exist, all of which are relatively small.

Family Cyprinidae - the minnow family. Certain members of this family have adapated to living in diverse environmental conditions. Some minnows require water with a high dissolved oxygen content; others, such as the carp, can live almost anywhere. The cyprinids are omnivorous feeders. Smaller members of this family are important as food fish for larger fish.

Family Gadidae - the codfish family which includes some of the most valuable food fishes, such as burbot of Lake Mighican.

Family Osmeridae - the family of the true smelt. These are small inshore cold-water fishes in the northern hemisphere.

Family Percidae - the perch family. This family includes the yellow perch and the walleye, both important economically in commercial and recreational fisheries.

Family Percopsidae - the troutperch. The troutperch live in shoal water of the Great Lakes and some larger inland lakes. They are important as food for gamefish.

Family Salmonidae - the salmon family. The Salmon, trout, and whitefish make up this family of fish. The salmonids live in streams and cold-water lakes and require higher concentrations of oxygen and lower water temperatures than most families. They are very important economically both in commercial and recreational fisheries.

seawall - a structure separating land and water areas primarily designed to prevent erosion and other damage due to wave action.

seiche - a periodic, rapid, and often violent fluctuation or oscillation of the water level of a lake most often caused by winds and barometric pressure. A seiche often occurs after a prolonged period of strong winds from the same direction which causes the water of a lake to pile up on

its windswept side. Seiches can cause fluctuations in water levels of up to eight feet which may result in serious flooding of, or damage to, the adjacent shorelands.

shoal - a place where water is shallow, sometimes created by a sandbar, in the shipping channels, created by deposition of eroded material.

shore - a strip of land bordering any body of water. A shore of unconsolidated materials is usually called a beach.

shorelands - those lands, waters, and lands beneath the waters in close proximity to the shoreline of the Great Lakes. Included, for the purposes of the study, are uplands extending one-halt mile landward of the shoreline and bottomlands and waters extending two miles lakeward of the shoreline.

shorelines - the line forming the intersection of the water with the shore. This line, of course, will vary depending upon the water levels of the Great Lakes.

shoreline protection - structural measures designed for placement along the shore to relieve erosion and flooding damages. Examples of structural measures are protective beaches, seawalls, groins and revetments.

shore type - the character of the shoreland immediately adjacent to the shoreline based upon the physical features of height, composition and erodibility. Shoretypes used in this study are low plain, high bluff, low bluff, high dune, wetlands, and artificial.

slope - the degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating 1 unit rise in 25 units of horizontal distance; or in a decimal fraction (0.04); degrees (2^{o} 18'); or percent (4%). It is sometimes described by such adjectives as: steep, moderate, gentle, mild or flat.

still water level - the elevation of the surface of the water if all wave action were to cease.

substrate - any substance used as nutrient by a microorganism.

tide - the periodic rising and falling of the water that results from the gravitational attraction of the moon and sun acting on the rotating earth.

topography - the configuration of a surface including its relief, the position of its streams, roads, buildings, etc.

turbidity - condition of water caused by the presence of suspended matter, resulting in the scattering and absorption of light rays.

water quality - the chemical, physical, and biological characteristics of water with respect to its suitability for a particular purpose.

wave - a ridge, deformation, or undulation of the surface of a liquid.

SECTION 111

ENVIRONMENTAL STATEMENT

MITIGATION OF SHORE DAMAGE ATTRIBUTED TO THE FEDERAL NAVIGATION STRUCTURES AT HAMMOND BAY HARBOR, MICHIGAN

APPENDIX A

ECONOMIC DATA
EXTRACTED FROM
U.S. ARMY CORPS OF ENGINEERS
SECTION 111 DETAILED PROJECT REPORT
ON
SHORE DAMAGE AT
HAMMOND BAY HARBOR, MICHIGAN

APPENDIX A

ECONOMIC DATA

It is recommended that a project be authorized for mitigation of shore damages attributable to Federal navigation works at Hammond Bay Harbor, Michigan, to construct a groin and refill an eroded beach pocket as a means of improvement as described in the Section 111 Detailed Project Report. If this project is accepted, costs of all installation, operation, and maintenance are to be under Section 111 authority and will be a Federal responsibility with no conditions required for local operation.

COSTS

Table 1 summarizes the estimated cost of an artificially-filled groin at Hammond Bay Harbor. Allowances for mobilization, overhead, and contingencies have been included. About 150 linear feet of rock groin are required, costing $100 per foot. Additionally, 3,000 cubic yards of imported sand and gravel fill are required to fully mitigate the harbor-caused erosion at a cost of about $5 per cubic yard. Allowing for site cleanup, mobilization costs, real estate acquisition, overhead, and contingencies brings the total capital cost estimate to $60,400 based on 1976 dollars. This is equivalent to an annualized cost of $4,000 (based on 6-3/8% interest over a 50 year project life) which when summed with expected periodic inspection and routine maintenance costs of $3,000 per year results in a total annual cost of $7,000.

TABLE 1. SUMMARY OF COSTS FOR HAMMOND BAY HARBOR EROSION MITIGATION PROJECT

COST ITEM	FIRST COST	ANNUAL COST
Cost of constructing rock groin, 150 lin ft @ $100/ft	$15,000	
Sand and gravel fill (imported), 3,000 cu yd @ $5/cu yd	$15,000	
Site cleanup	$ 1,000	
Mobilization costs	$ 3,000	
Subtotal	$34,000	
Contingencies (15%)	$ 5,100	
Subtotal	$39,100	
Engineering and Design	$15,100	
Supervision and Administration	$ 3,800	
Real Estate Acquisition	$ 2,500	
Total	$60,400	$4,300*
Periodic Inspection & Maintenance		$3,000
Total Annual Costs		$7,000

*Total First Cost annualized at 6-3/8% over 50 years.

BENEFITS

Beach erosion control benefits were evaluated according to the procedure outlined in EM 1120-2-108 to assess (1) benefits from prevention of damage, (2) benefits from enhancement of property values, and (3) recreational benefits. Table 2 summarizes the expected benefits of the proposed project.

A survey of land values of lakefront property was made. Based upon estimates by local realtors, county equalization officials, and various private citizens, it was concluded that lakefront property north of Hammond Bay Harbor varies in value from nearly zero for unusable land to about $125 for prime property. Values are generally set on a front-foot basis. The range of values for buildable property is generally narrow, ranging between $100 and $125. Land subject to high erosion faces the greatest prospect of losing its value.

At least one lot which lies immediately beyond the worst erosion area is in this category. If the State of Michigan proceeds with its plans to establish minimum building setback regulations, and the present erosion rate remains unchecked, a strip 300 to 500 feet wide may become unbuildable. If erosion is halted it is unlikely that setback requirements would be large enough to influence the value. Assuming a minimum usable lot depth of 100 feet, the value per square foot is about $1.25. The usable depth is what is left after deducting beach and unbuildable setback areas.

There are, at most, three structures presently located along the shoreline which would face significant danger if present erosion rates were to continue for 50 years. Eventually all

TABLE 2. SUMMARY OF ANNUAL BENEFITS FOR HAMMOND BAY HARBOR EROSION MITIGATION PROJECT

BENEFIT	ANNUAL DOLLAR BENEFIT
Prevention of land loss	$ 7,900
Prevention of damage to development	
Roadways	$1,700
Structures	$ 100
Recreation	$ nil
TOTAL	$9,700

would have to be moved or abandoned if erosion were not reduced. The cost of moving an average single-family dwelling is estimated to be about $10,000. At least one other house has been removed to another location since harbor construction.

U.S. Route 23, a two lane highway, fronts the lake on both sides of the harbor. The highway lies within 100 feet of the eroded bluff at one point. If the present erosion rate at that point were to continue, the highway would be threatened within 20 years. This would then require either expensive protective work or relocation of the highway. Since the highway is straight in this location, relocation would entail either the introduction of a hazardous curve or extensive realignment. The cost of a new roadbed and paving is estimated to be about $350,000 per mile. It is assumed that realignment would require at least 1/2 mile of new roadway.

Benefits from structural damage prevention are broken into two groups: (a) loss of land, and (b) damage to development. About 6,300 square feet of land are lost annually within the range of influence of the harbor. It is believed that the proposed project could save this land. At $1.25 per square foot, this benefit would amount to $7,900 annually. Due to normal wear and ageing, the pavement of the endangered roadways will have to be replaced even if the threat of erosion were stopped. The cost of grading and easement are estimated as half the roadway cost. So the benefit from saving 1/2 mile of roadway is estimated as about $87,000 over the life of the project. The roadway section would begin to washout in about twenty years based on the present rate of erosion. The average annual benefit from prevention of damages to U.S. Highway 23

would be $1,700, based on an interest rate of 6 3/8%. This is less than the cost of extensive bank protection to save the existing roadway. The total cost of not having to remove the three structures is estimated at $30,000. However, it is estimated these structures will not have to be moved until somewhere near the end of the 50-year project life if the present rate of erosion continues. The average annual benefit from the prevention of the removal of the structures would be $100.

Benefits would also result in enhancement of property values. About 400 feet of lake frontage has eroded to such an extent that, with the potential for continuing damage, it must be considered worthless. Another 600 feet will probable face such a demise if the present rates continue for the next 50 years. Beyond this combined 1,000 foot reach is another 800 foot reach which will decline in value but remain buidable. If erosion is stopped, or even substantially reduced, all of this frontage can be saved. However, it is felt that land enhancement benefits from prevention of this loss of lake frontage is already fully taken into account under the previously discussed loss of land benefit category. Therefore, no land enhancement benefits are claimed.

The population of Bearinger Township is so small, even on a seasonal basis, and sandy beaches are so abundant that the production of additional recreational beach is expected to have a very small and localized value. Most of this value would be reflected in land appreciation values already considered above. Therefore, no additional recreational benefit is monetized. As shown in Table 2, the annual worth of the benefits amounts to about $21,000.

4/14/77

There are various intangible benefits on which a dollar value cannot be placed. These include general aesthetics and the alleviation of homeowners' concern that their property is slowly shrinking in value with no apparent solution as slowly their lands wash into the Lake. The intangible benefits at Hammond Bay Harbor are not considered to be significant compared to other benefits.

COMPARISON OF COSTS AND BENEFITS

The annual cost of the proposed project is estimated at $7,000. The annual worth of the benefits for a 50-year project period are $9,700. The ratio of annual benefits to costs is 1.4, which indicates that the proposed project is economically justified.

SECTION III

ENVIRONMENTAL STATEMENT

MITIGATION OF SHORE DAMAGE ATTRIBUTED TO THE FEDERAL NAVIGATION STRUCTURES AT HAMMOND BAY HARBOR, MICHIGAN

APPENDIX B

PERTINENT CORRESPONDENCE

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
GREAT LAKES SURVEILLANCE BRANCH
1819 W. PERSHING RD
CHICAGO, ILLINOIS 60609

December 12, 1975

Mr. Frark Gerard
Tetra Tech
630 North Rosemead Boulevard
Pasadena, California 91107

Dear Mr. Gerard:

As you requested in our telephone conversation of 11 December 1975, I have enclosed copies of the latest sediment quality surveys for the following harbors:

Frankfort, Michigan
Manistee, Michigan
Hammond Bay, Michigan

I hope this data is helpful to you in your Section 111 erosion studies.

Sincerely yours,

Anthony G. Kizlauskas

Enclosures as
stated

NCRCO-O

TO FILE — FROM Ch, O&M Br — DATE 15 Dec '75

BILLMAIER/la/2000

1. On 5 December 1975, the following persons met at the Great Lakes Fishery Laboratory, Ann Arbor, Michigan:

Vern Lang	Federal F&W Serv., E. Lansing
Dave Allardyce	" " "
Robert Nester	Great Lakes F&W, Ann Arbor
Tom Yosco	" " "
Jarl Hiltunen	" " "
Bruce A. Ma-ny	" " "
Thomas Edsall	" " "
Ray Lawrence	Waterways, Michigan - DNR (Representing Mr. Dale Granger)
Harry A. Doehne	Federal State Coord., Michigan DNR
Gary Coopes	Environmental Review, Mich - DNR
Henry Vondette	Fisheries Division, Michigan DNR
Ludvig Trombenberger	" " "
Joseph V. Cook	MDSH & T, State of Michigan
Jack Collis	Environmental Br., Det., C. of E.
Stanley R. Jacek	Proj Opns Det, Corps of Engr
Donald L. Billmaier	O&M Br., Det., Corps of Engr

2. This meeting between the Federal Fish and Wildlive, the Michigan DNR and the District was a continuation of our discussions relative to dredge scheduling, open water disposal, beach disposal and the exchange of problems and concerns. The last such meeting being 11 April 1975, followed by a field trip aboard the U. S. Dredge HAINS on 3 May 1975. This meeting was agreed to at the conclusion of the 11 April meeting as being a better time to incorporate desires and suggestions of the other agencies.

3. Although all phases of our dredging programs eventually enter into the discussions, the primary topics are calendar time by project and method of disposal of unpolluted materials.

4. I opened the meeting with a summary of which projects are in our proposed 1976 (season) dredging program, which are proposed for Hopper Dredge, the needs of various projects, early season ice conditions and the economics of full utilization of the Hopper Dredge. The Federal and State Fishery, people have been concerned over our scheduling of maintenance dredging at St. Joseph Harbor and immediately questioned our intentions for 1976. I then described our proposed plans of implementing the Section III project, including how this differed from our past practice of "alternate disposal" on beaches and/or shallow contours. At this point, we discussed the appropriate (or agreeable) time to dredge each project. With concessions from some previous strongly expressed viewpoints, and in light of the Section III project at St. Joseph coupled with the lack of commerce at South Haven, I agreed to the following general schedule for Lake Michigan projects via Hopper Dredge. Both the Federal and State Fishery people expressed their satisfaction with the arrangement. Start at Holland

cc [illegible]

Harbor entrance channel or Grand Haven Harbor entrance channel as ice allows. In either case, complete both of above before proceeding to Muskegon, White Lake, Ludington and Manistee in that order. To have Manistee completed by 1 June 1976, then go to St. Joseph for the Section 111 project. Reserve South Haven maintenance dredging for "fill in" work should any operational problems be encountered in the rehandling of material at St. Joseph. After 4 July 1976 return to Northern Lake Michigan projects. Inner portion of Grand Haven Harbor (polluted) would be accomplished in late fall, unless shoaling was extremely serious. There was no objections to our normal shoaling practic for the remainder of the 1976 season.

5. Jack Collis described our program for examining each open water disposal location including those on shallow contours and that our intent was to examine each before its next utilization. He included how, in the one instance encountered to date, a different open water disposal location was selected when the previous location appeared be acceptable to fish spawning. Our expectations were surpassed. This program was entirely acceptable to all present and has apparently resolved Federal and State fish objections to these disposal locations including those on shallow contours.

6. Mr. Jacek briefly described our efforts to date towards establishment of a monitoring program at confined disposal facilities and dredging operations.

DONALD L. BILLMAIER
Chief, Operations and Maintenance Branch
Construction-Operations Division

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

January 2, 1976

Colonel James E. Hays
District Engineer
U.S. Army Engineer
Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Hays:

The Michigan Department of Natural Resources appreciates the cooperation of the Detroit District in utilizing dredged material from harbor maintenance for the purpose of erosion control and beach nourishment. We fully support the beach nourishment concept and we urge that as much material as possible be placed on the beach again in 1976. If possible, we would suggest that beach nourishment be written into the contracts for harbors which are now being maintained by private dredging firms.

There have been some conflicts in past years between dredging and the spring salmon and trout fishery in southern Lake Michigan. It is my understanding that this problem has been worked out to the satisfaction of our respective staffs. We also agree with the concept of using divers to evaluate offshore and near shore (18-25 foot contour) disposal areas, as stated in my letter of 12/10/75 to Mr. McCallister. We look forward to the reports of your findings in this new program.

Thank you for your cooperation regarding this matter.

Sincerely,

Howard A. Tanner

Howard A. Tanner
Director

TETRA TECH, INC.
630 NORTH ROSEMEAD BLVD.
PASADENA, CALIFORNIA 91107
TELEPHONE (213) 449-6400

22 April 1976

Michigan Department of State
Michigan History Division
Administrative Publications
Research and Historic Sites
208 North Capitol Avenue
Lansing, Michigan 48918

Attention: James E. Fitting
State Archaeologist

Dear Mr. Fitting:

Our organization is preparing three Environmental Impact Statements under contract with the U.S. Army Corps of Engineers.

Within each EIS there will be a section concerning existing environmental conditions. We would therefore appreciate any archaeological data you could supply with respect to shoreline sites:

(1) along the Lake Michigan shoreline in the vicinity of Frankfort and Manistee Harbors; and

(2) along the Lake Huron shoreline in the vicinity of Hammond Bay Refuge Harbor.

We are also interested in determining if any archaeological surveys have been conducted in these areas of interest and if so, by whom and the results thereof.

If you should have any questions regarding our inquiries, please don't hesitate to call me at (213) 449-6400.

Thanking you in advance,

James F. La Morte, III
Environmental Engineer
Engineering Division

JFL:st

TETRA TECH, INC.
630 NORTH ROSEMEAD BLVD.
PASADENA, CALIFORNIA 91107
TELEPHONE (213) 449-6400

23 April 1976

Francis T. Mayo
Regional Administrator
Region V
Environmental Protection Agency
1 N. Wacker Drive
Chicago, IL 60606

Dear Mr. Mayo:

Our organization is preparing three Environmental Impact Statements under contract with the U.S. Army Corps of Engineers. The scope of work involves mitigation of shore damage attributed to Federal Navigation Structures at Manistee (Manistee County) and Frankfort (Benzie County) Harbors, and Hammond Bay Refuge (Presque Isle County) Harbor, Michigan.

Studies have uncovered no detailed air quality data for the three sites under consideration. A more general evaluation of air quality would be enhanced with the addition of EPA data. We therefore request such information on the air quality characteristics of Region V; specifically Benzie, Manistee, and Presque Isle Counties. Such information should include priority ratings for the respective areas.

Please respond to us at the following address:

Tetra Tech, Inc.
630 North Rosemead Boulevard
Pasadena, CA 91107

Attention: James F. La Morte, III

Sincerely,

James F. La Morte, III

James F. La Morte, III
Environmental Engineer
Engineering Division

JFL:st

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST
CHICAGO ILLINOIS 60604

MAY 06 1976

Mr. James F. La Morte, III
Environmental Engineer
Tetra Tech., Inc.
630 North Rosemead Boulevard
Pasadena, California 91107

Dear Mr. La Morte:

This is in reply to your letter of April 23, 1976, to our Region V office.

There are only two monitoring sites for the area of your concern. Both sites are located in Manistee County and are operated by the Michigan Department of Natural Resources. The locations of the monitors are as follows:

233180001F01 -
Sewage Treatment Plant, Manistee

233200001F01 -
Filer City Road and 25th Street, Manistee County

The summary of data below is for suspended particulate and is in units of ug/m^3.

		Year	Num. obs.	Max obs.	Arith. Mean
233180001F01	-	1974	40	161	71
		1975	26	137	66
233200001F01	-	1974	40	126	47
		1975	24	97	48

The Counties of Manistee, Benzie, and Presque Isle are located in AQCR 126 which is priority III for suspended particulate, sulfur dioxide, carbon monoxide, and oxidants.

If you have need of more information please call Mr. Stephen Goranson

of our Air Surveillance Branch at (312) 353-1447.

Sincerely yours,

Christopher Mr. Timm, Director
Surveillance and Analysis Division

TETRA TECH, INC.
630 NORTH ROSEMEAD BLVD.
PASADENA, CALIFORNIA 91107
TELEPHONE (213) 449-6400

26 April 1976

Martha M. Bigelow
Director, Michigan History Division
and
State Historic Preservation Officer
3423 North Logan Street
Lansing, Michigan 48918

Dear Ms. Bigelow:

Our organization is preparing three Environmental Impact Statements under contract with the U.S. Army Corps of Engineers. The scope of work involves mitigation of shore damage attributed to Federal Navigation Structures at Manistee (Manistee County) and Frankfort (Benzie County) Harbors and Hammond Bay Refuge Harbor (Presque Isle County), Michigan.

We have consulted the National Register of Historic Places listed in the 10 February 1976 issue of the Federal Register and its 6 April supplement. The following properties are identified for the counties in which studies are being conducted:

Benzonia City	—	MILLS COMMUNITY HOUSE, MILLS COTTAGE 891 Michigan Avenue
Manistee City	—	FIRST CONGREGATIONAL CHURCH 412 South Fourth Street
	—	OUR SAVIOR'S EVANGELICAL LUTHERAN CHURCH (DANISH LUTHERAN CHURCH) 300 Walnut Street
	—	RAMSDELL THEATRE 101 Maple Street
Presque Isle City	--	OLD PRESQUE ISLE LIGHTHOUSE Off State Route 405

Would you please review the Register to verify that all historical sites have been properly identified. Your response should be directed to:

TETRA TECH, INC.
630 North Rosemead Boulevard
Pasadena, CA 91107

Attention: James F. La Morte

Thanking you in advance,

James F. La Morte, III

James F. La Morte, III
Environmental Engineer
Engineering Division

JFL:st

MICHIGAN DEPARTMENT OF STATE
RICHARD H. AUSTIN SECRETARY OF STATE

LANSING
MICHIGAN 48918

MICHIGAN HISTORY DIVISI
ADMINISTRATION, ARCHIVES, HISTORIC SITES, AND PUBLICAT
3423 N. Logan Street
517-373-0510
STATE MUSEUM
505 N. Washington Avenue
517-373-0515

May 24, 1976

Mr. J. F. LaMorte, III
Engineering Division
Tetra Tech, Inc.
630 North Rosemead Blvd.
Pasadena, California 91107

Dear Sir:

Our staff has reviewed the areas proposed for U.S. Army Corps of Engineers operations as delineated in your letter of April 26, 1976, and offers the following comments.

Historic
Your letter of April 26, 1976, correctly lists the National Register sites in these areas. It is unlikely that these listed sites or others eligible for listing will be impacted by COE operations, but we cannot ascertain this until all treatment alternatives are examined. We therefore reserve the right to offer further comments when the Draft Environmental Statement is submitted. You may contact Dr. Lawrence Finfer, Environmental Review Coordinaotr, if you have further questions concerning the historic aspects of the projects.

Archaeological
The Museum of Anthropology, University of Michigan lists archaeological sites near both Hammond Bay Refuge Harbor and the mouth of the Manistee River. No sites are recorded in Frankfort, but this is due to the fact that no archaeological work has been conducted in there; a Michigan State University survey of the Sleeping Bear Dunes region just north of Frankfort disclosed sites. We therefore cannot ascertain the impacts until all treatment alternatives are presented, and reserve the right to offer further comments when the Draft Environmental Statement is submitted. You may contact Dr. John R. Halsey, State Archaeologist, if you have further questions concerning the archaeological aspects of the projects.

Please note that we are willing to make further comments before the issuance of Draft Environmental Statements if the project alternatives are delineated. Thank you for giving us the opportunity to comment.

Sincerely yours,

Martha M. Bigelow

Martha M. Bigelow
Director, Michigan History Division
and
State Historic Preservation Officer

MMB/LF/cw

TETRA TECH, INC.
630 NORTH ROSEMEAD BLVD
PASADENA, CALIFORNIA 91107
TELEPHONE (213) 449-6400
TELEX NO 67-8345
TETRATECH PSD

18 June 1976

Martha M. Bigelow
Director, Michigan History Division
and
State Historic Preservation Officer
3423 North Logan Street
Lansing, Michigan 48918

Dear Ms. Bigelow:

We have contacted your agency previously in regard to the preparation of several Environmental Impact Statements for the Army Corps of Engineers. Your response and your agency's cooperation have been very helpful in determining impacts of proposed projects that mitigate harbor-caused damage at Frankfort, Manistee, and Hammond Bay Harbors, Michigan. In this regard, additional information is requested concerning the Hammond Bay vicinity.

Following detailed engineering studies of shoreline erosion in the vicinity of the refuge harbor at Hammond Bay, a plan for eliminating harbor-induced erosion was tentatively selected from twelve alternatives. The plan calls for the construction of the 150-foot groin at the site of harbor-caused erosion just north of the harbor, as shown in the enclosed map. In addition, the beach running about 450 feet north of the proposed groin will receive about 3,000 cubic yards of fill material. A great majority of the land affected by these two construction actions will be wave-washed beach and submerged lands in the littoral zone.

I have been in contact with Dr. Lawrence Finfer concerning the potential historical impacts of the proposed project, and with Dr. John Halsey in regard to potential archaeological impacts. Both authorities have indicated, based on brief and preliminary telephone descriptions of the proposed project, that impacts to historical, archaeological, or other cultural sites are <u>not</u> expected. It is hoped that the details in this letter will allow a more complete evaluation of potential impacts by you and your agency. Please relay the results of your analysis as soon as possible. Please call me if you have questions or new information concerning this project. My telephone number is (213) 449-6400, Extension 330. Thank you again for your cooperation.

Sincerely,

James F. La Morte, III

James F. La Morte, III
Environmental Engineer
Engineering Division

JFL:st

Enclosure: Map

RICHARD H. AUSTIN SECRETARY OF STATE

LANSING
MICHIGAN 48918

MICHIGAN HISTORY DIVISION
ADMINISTRATION, ARCHIVES, HISTORIC SITES, AND PUBLICATIONS
3423 N Logan Street
517-373-0510
STATE MUSEUM
505 N Washington Avenue
517-373-0515

June 22, 1976

Mr. J. F. LaMorte, III
Engineering Division
Tetra Tech, Inc.
630 North Rosemead Blvd.
Pasadena, California 91107

Dear Sir:

Our staff has reviewed the proposals to mitigate shore damage at Manistee and Hammond Bay Harbors, Michigan, and concludes that they will have no effect on cultural resources.

Thank you for giving us the opportunity to comment.

Sincerely yours,

Martha M. Bigelow
Director, Michigan History Division
and
State Historic Preservation Officer

MMB/LF/cw

TETRA TECH, INC.
630 NORTH ROSEMEAD BLVD.
PASADENA, CALIFORNIA 91107
TELEPHONE (213) 449-6400

26 April 1976

Mr. William T. Murtagh
Keeper of the National Register
U.S. Department of the Interior
National Park Service
Washington, D.C. 20240

Dear Mr. Murtagh:

Our organization is preparing three Environmental Impact Statements under contract with the U.S. Army Corps of Engineers. The scope of work involves mitigation of shore damage attributed to the Federal Navigation Structures at Manistee (Manistee County) and Frankfort (Benzie County) Harbors and Hammond Bay Refuge Harbor (Presque Isle County), Michigan.

We have consulted the National Register of Historic Places listed in the 10 February 1976 issue of the Federal Register and its 6 April supplement. The following properties are identified for the counties in which studies are being conducted:

Benzonia City	—	MILLS COMMUNITY HOUSE MILLS COTTAGE 891 Michigan Avenue
Manistee City	—	FIRST CONGREGATIONAL CHURCH 412 South Fourth Street
	—	OUR SAVIOR'S EVANGELICAL LUTHERAN CHURCH (DANISH LUTHERAN CHURCH) 300 Walnut Street
	—	RAMSDELL THEATRE 101 Maple Street
Presque Isle City	—	OLD PRESQUE ISLE LIGHTHOUSE Off State Route 405

We have also consulted the National Register of Natural Landmarks and find that none exist within the counties of interest.

Would you kindly review the National Register to ensure that all historical sites and national landmarks are properly identified and respond to us at the following address:

TETRA TECH, INC.
630 North Rosemead Boulevard
Pasadena, CA 91107

Attention: James F. La Morte

Thanking you in advance,

James F. La Morte, III

James F. La Morte, III
Environmental Engineer
Engineering Division

JFL:st

United States Department of the Interior

NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:
H34-PR

MAY 24 1976

Mr. James F. La Morte, III
Environmental Engineer
Tetra Tech., Inc.
630 North Rosemead Boulevard
Pasadena, California 91107

Dear Mr. La Morte:

Thank you for your letter of April 26, 1976, concerning your organization's preparation of environmental impact statements for U.S. Army Corps of Engineers mitigation of shore damage projects at Manistee, Frankfort and Hammond Bay Refuge Harbors, Michigan.

You have correctly identified those properties in Manistee, Frankfort, and Presque Isle Counties that are listed in, determined eligible for inclusion in, or are currently pending nomination in this office to the National Register, but there may be other historic and cultural resources in these areas that should be considered by the Corps of Engineers projects.

Under section 800.4(a)(2) of the Advisory Council on Historic Preservation's procedures for implementing the Executive order, Federal agencies are to identify all historic and cultural resources in the area of a proposed undertaking at the earliest stage of planning and to request that the Secretary of the Interior determine their eligibility for inclusion in the National Register.

Requests for determinations of eligibility, along with the necessary supporting documentation, may be submitted directly to this office. Enclosed for your convenience are instructions explaining the documentation necessary for our review of such requests.

As the first step in the identification of other resources that may be eligible for listing in the National Register, we recommend that you consult the Michigan State Historic Preservation Officer, Dr. Martha M. Bigelow, Director, Michigan History Division, Department of State, Lansing, Michigan 48918, who will be able to advise you concerning any resources that might be included in a State survey and the need for additional surveys of the project area. If we may be of any further assistance, please do not hesitate to let us know. We appreciate your cooperation with historic preservation planning.

Sincerely yours,

William J. Murtagh
Keeper of the National Register

Enclosures

TETRA TECH, INC.
630 NORTH ROSEMEAD BLVD.
PASADENA, CALIFORNIA 91107
TELEPHONE (213) 449-6400

26 April 1976

Mr. Robert Garvey
Executive Director
Advisory Council on Historic
Preservation, Suite 430
1522 "K" Street, N.W.
Washington, D.C. 20005

Dear Mr. Garvey:

Our organization is preparing three Environmental Impact Statements under contract with the U.S. Army Corps of Engineers. The scope of work involves mitigation of shore damage attributed to Federal Navigation Structures at Manistee (Manistee County) and Frankfort (Benzie County) Harbors and Hammond Bay Refuge Harbor (Presque Isle County), Michigan.

We have consulted the National Register of Historic Places listed in the 10 February 1976 issue of the Federal Register and its 6 April supplement. The following properties are identified for the counties in which studies are being conducted:

Benzonia City	--	MILLS COMMUNITY HOUSE, MILLS COTTAGE 891 Michigan Avenue
Manistee City	—	FIRST CONGREGATIONAL CHURCH 412 South Fourth Street
	—	OUR SAVIOR'S EVANGELICAL LUTHERAN CHURCH (DANISH LUTHERAN CHURCH) 300 Walnut Street
	—	RAMSDELL THEATRE 101 Maple Street
Presque Isle City	—	OLD PRESQUE ISLE LIGHTHOUSE Off State Route 405

Would you please review the Register to verify that all historical sites have been properly identified. Your response should be directed to:

TETRA TECH, INC.
630 North Rosemead Boulevard
Pasadena, CA 91107

Attention: James F. La Morte

Thanking you in advance,

James F. LaMorte, III

James F. La Morte, III
Environmental Engineer
Engineering Division

JFL:st

Advisory Council
On Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005

June 7, 1976

Mr. James F. La Morte, III
Environmental Engineer
Engineering Division
Tetra Tech, Inc.
630 North Rosemead Boulevard
Pasadena, California 91107

Dear Mr. La Morte:

The Advisory Council on Historic Preservation is charged with reviewing and commenting on federally funded, licensed, or approved projects that affect properties included in or eligible for inclusion in the National Register of Historic Places.

To date you have correctly identified those properties included in the National Register. Your next step is to identify those properties that may be eligible for inclusion in the National Register. The letter of May 24, 1976, to you from the Keeper of the National Register explains the process to you.

Once all properties that are in or eligible for inclusion in the National Register have been identified, the Corps of Engineers should apply the Criteria of Effect and the Criteria of Adverse Effect, as appropriate, as indicated in Section 800.4(a) of our "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800), a copy of which is enclosed for your information. The Corps should then proceed with the subsequent steps of the procedures, as appropriate.

We hope we have helped you. Should you have any other questions or desire additional assistance, please contact us.

Sincerely yours,

John D. McDermott
Director, Office of Review
and Compliance

TETRA TECH, INC.
630 NORTH ROSEMEAD BLVD.
PASADENA, CALIFORNIA 91107
TELEPHONE (213) 449-6400

7 June 1976

Eugene Mote
Building and Zoning Commission
151 East Huron
Rogers City, Michigan 49779

Dear Mr. Mote:

Tetra Tech, Inc., of Pasadena, California, is conducting an investigation of Presque Isle County in a study for the Army Corps of Engineers. Your assistance is requested in our efforts to characterize the county and, specifically, the shoreline in the vicinity of Hammond Bay Refuge Harbor. Would you please send any land-use data for the county, Rogers City, and the harbor area that includes percentages of residential, commercial, industrial, public, and transportation land uses. Are such uses expected to change significantly in the future? Does any one land use (i.e., residential) receive special emphasis in community concerns?

Our investigations concern shoreline erosion that may be attributable to the refuge harbor structures at Hammond Bay. In this regard, could you supply building set-back limits and property values (in general) that may apply to our study area? For your convenience, a map showing the area of concern is enclosed. Finally, what future do you see for the Hammond Bay shoreline? Will seasonal residences continue to dominate land usage?

Thank you, Mr. Mote, for your time and effort in answering our inquiries. Please respond to:

Tetra Tech, Inc.
630 North Rosemead Boulevard
Pasadena, CA 91107

Attn: Mr. James F. La Morte, III

Sincerely,

Jim LaMorte

Jim La Morte, III
Environmental Engineer
Engineering Division

JFL:st

TETRA TECH, INC.
630 NORTH ROSEMEAD BLVD
PASADENA CALIFORNIA 91107
TELEPHONE (213) 449 6400
TELEX NO 67 3349
TETRATECH PSD

7 June 1976

Dr. Joseph Kutkuhn
Director, Great Lakes Fisheries Laboratory
1451 Green Road
Ann Arbor, Michigan 48105

Attention: Dr. Bruce Manny

Dear Dr. Kutkuhn:

Tetra Tech, Inc., of Pasadena, California, is conducting an investigation of the vicinity of the Hammond Bay Refuge Harbor in a study for the Army Corps of Engineers. This study investigates shoreline erosion attributable to the harbor structures and will recommend to the Corps a specific plan to mitigate such erosion. In accordance with the National Environmental Policy Act of 1969, an environmental statement is under preparation and will describe the impacts associated with the proposed plan. Your assistance is requested in our efforts to describe the environmental setting of the project area for inclusion in the EIS.

In a recent telephone conversation with Dr. Bruce Manny, I was made aware of a detailed ecological survey and inventory of the shoreline adjacent to the Hammond Bay Refuge Harbor. The results of Dr. Manny's survey are found in an EER inventory form entitled "Inventory for Consideration of the Hammond Bay Area as an Experimental Ecological Reserve." This document would be of great value in our study efforts. In addition, water quality data for station #18 (near the mouth of the harbor) would also be of help.

Thank you for your time and consideration in this research. If you have any specific questions or require information that I may supply, please contact me at (213) 449-6400. I look forward to the future coordination and exchange of information between our respective agencies.

Sincerely,

James F. LaMorte, III
Environmental Engineer
Engineering Division

JFL:cmw

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO

Great Lakes Fishery Laboratory
1451 Green Road
[redacted]
Ann Arbor, Michigan [redacted] 48105

June 15, 1976

Mr. James F. LaMorte, III
Environmental Engineer
Tetra Tech, Inc.
630 North Rosemead Blvd.
Pasadena, California 91107

Dear Mr. LaMorte:

Dr. Kutkuhn referred your letter requesting information about the environmental setting of the Hammond Bay Refuge Harbor to me for reply.

Enclosed please find an inventory form prepared in support of the Hammond Bay area, and our USFWS Biological Laboratory in particular, as an experimental ecological reserve study site. On April 5, 1976, notification was received from the Institute of Ecology that the site would be included in NSF's national registry of ecologically worthy sites, based on an established history of environmental studies going back to the 1950's.

Also enclosed is a table of values for water chemistry variables in surface and bottom waters of the nearshore zone 50 meters directly off the mouth of the Hammond Bay Refuge Harbor during the ice-free season in 1974 and a figure depicting turbidity in Greene Creek 5 km north of Refuge Harbor and at the water intake (from the 4-m depth contour) of the Hammond Bay Biological Station, 10 km south of Refuge Harbor. The higher variation in turbidity values at the water intake, compared with Greene Creek, was caused by resuspended detritus in the nearshore waters as a result of strong winds out of the north and northwest. Turbidity in Hammond Bay usually clears within 2-3 days following a storm.

Please give me a call if you have further questions.

Sincerely,

Bruce A. Manny

Bruce A. Manny
Fishery Biologist

CONSERVE AMERICA'S ENERGY

B-22

Save Energy and You Serve America!

Please type this form and utilize the attached instructions.

GENERAL INFORMATION

1. Hammond Bay Biological Station (name of site) 2. 517-734-2511 (telephone) 3. Presque Isle (county)

4. R.F.D. Millersburg (street/P.O.Box) Michigan (city) 49759 (state)(ZIP) 5. MICHIGAN (state)

6. Latitude: 45 ° 30' " 7. Longitude: 84 ° 2' "

8. Access directions: On Route 23; 56 km south of Cheboygan, Michigan and/or 20 km north of Rogers City, Michigan.

9. Commercial transportation: Air 96 km. Train 56 km. Bus 56 km.

10. Ownership: U.S. Fish and Wildlife Service, Department of the Interior

11. Management: ditto

SITE QUALITY

20. Land-use directive: Experimental, aquatic, ecological research (basic and applied). Specifically, Develop means to control parasitic sea lampreys and Research the biological productivity of the Great Lakes nearshore ecosystem.

21. Length of above commitment: permanent ___X___ year begun 1949
temporary _____ year begun _____ anticipated termination date _____

22. Total size: 6.8 ha 23. Altitude: minimum 176 m
maximum 178 m

30. Vegetation classification:

32. Habitat types and size: Shallow, nearshore Great Lakes shoreline of very high water quality; sandy beaches, rock-cobble wave zones, red cedar swamps behind beaches succeeded by pine stands and then hardwoods.

35. Description of biotic components: Nearshore waters: Steelhead trout, Lake trout, Splake, Whitefish, Alewives, Smelt, and smallmouth bass inhabit the clear, unpolluted waters. Spawning and nursery grounds for most Great Lakes fish species (sculpins, sticklebacks, suckers etc.). Sandy, cobbled bottom is scoured by ice in winter but harbors populations of stream invertebrates. Diverse assemblages of north american waterfowl present seasonally. Tributaries: Most are small, clear trout habitat possessing low specific conductance, moderate alkalinity, basic pH and abundant benthic invertebrates. Land behind beaches: Red cedar swamps, willow thickets & pine groves interspersed with occasional meadows of wild flowers, blueberries etc. which are bordered by alder and birch groves. Ruffed grouse, whitetail deer, black bear, porcupine, and fox squirrel, ospreys, horned owls and waterfowl are present.

40 Description of physical components: Sandy, porous soils (old beach mounts) drained by fast flowing streams into nearby Lake Huron. Undeveloped lands are forested with 2nd growth scrub oak, pine, some mixed hardwoods and alder groves. Beaches are swept clean annually by winter ice scouring; nearshore bottom substrate largely fine sands with rock-cobble zone near beaches. Impact of man has been slight since virgin timber was harvested in late 1800's. Present slow development of private home sites along lake shore will not effect overall character of the site for 15-20 years. Site is representative of undeveloped, northern, upper Great Lakes shoreline.

45. Control area: The Hammond Bay Biological Station occupies a permanent site on a promontory extending into Lake Huron from the SE corner of large, shallow, Hammond Bay. The site is mainained in a natural state and is surrounded largely by land held by the State of Michigan for recreation. About 50% of the Lake Huron shoreline 20 km north and south of Hammond Bay to about 1-3 km inland is protected by the State of Michigan for recreation.

50. Integrity of site: Immediately adjacent to the site are two small developments (communities) of seasonal resort cabins on the beach. No significant increase in human population near the site appears likely within the next 20 years owing to buffer zones of land held in their natural state by the State of Michigan. Long term integrity of the site appears favorable owing to the lack of industry and long distances from populus cities in southern Michigan.

RESEARCH HISTORY AND BASELINE INFORMATION
(Please append available information.)

	Available	Published	Appended for EER file
61. Species lists			
62. Vegetation maps			
63. Topographic maps	x		
64. Geological maps			
65. Climatological data	x		
66. Aerial photographs	x		
67. Bibliography	x		
68. Staff listing	x		x
69. Location maps	x		x
70. Soil maps	x		

75. Climatological station: on site _____/nearest station Rogers City (18 km)
80. Research history: Please see attached materials. Hammond Bay Biological Sta. is the primary study site for development of means to control and culture parasitic sea lampreys (Petromyzon marinus). Funds are provided by the Great Lakes Fishery Commission, administered under USFWF control at the Great Lakes Fishery Laboratory in Ann Arbor, Michigan. The site is presently also the focus of a comprehensive limnological research program on nutrient cycling and plankton productivity of nearshore fish spawning & nursery grounds.

RESEARCH AND TEACHING FACILITATION

Staff

90. Permanent staff: scientific 3 technical 4 support 2
91. Seasonal staff only: scientific 4 technical 4 support 1
92. Visiting scientists: sabbatical 1 short term 3
(per year)
95. Graduate students, thesis research: summer 1 full time _____
96. Total number of students: summer 1 full time _____

Financial:

100. Total site budget (includes grants): $200,000. (FY '76)

	Research%	Teaching% (as per cent of total budget)
101. Facility support:	14 %	%
102. Staff support:	86 %	%
103. Total teaching:		%
104. Total research:	100 %	

105. Other income and source: none

Facilities:

110. Physical plant: Greatest asset is the continuous supply of surface water from Lake Huron circulated throughout the laboratory from a water intake 200 meters offshore at 4.5 meters depth. The lab consists of a permanent building with six laboratory/culture rooms (2033 m^2), 4 offices (266 m^2), small library (66 m^2), three heated storage and construction buildings (700 m^2), small kitchen and no lodging facilities. Boat launch ramp to Lake Hu

112. Research equipment:

Two large fish raceways (2 X 3 X 20 m), numerous fish holding tanks and aquaria with controlled flow and temperature; 16 foot Boston Whaler outboard, 40 foot weather tower, standard limnological equipment, two autos, two trucks, analytical balance, Klett, pH meter, YSI conductivity meter, water filtration apparatus, YSI thermistor, Sonar, binoc and compound microscopes, recording

115. Outdoor laboratories: thermographs, photographic cameras, turbidometer, fluorometer, etc.

none.

120. Working environment: Unique opportunities are available to culture a variety of freshwater organisms in continuously flowing waters direct from Lake Huron. The quiet, isolated nature of the site is conducive to concentrated scientific effort as well as personal, outdoor recreation after work. The nearest town (Rogers City) is 18 km south of the study site.

125. Additional comments:

130. Authority for inventory data:

Name:	Dr. Bruce A. Manny
Position:	Project Leader
Address:	1451 Green Road Ann Arbor, Michigan 48105
Telephone:	313-994-3331

Return form and address questions to:

The Institute of Ecology
W. K. Kellogg Biological Station
Hickory Corners, MI 49060
(616)671-5202

TETRA TECH, INC.
630 NORTH ROSEMEAD BLVD.
PASADENA, CALIFORNIA 91107
TELEPHONE (213) 449-6400
TELEX NO. 67-5345
TETRATECH PSD

18 June 1976

Ned Fogle
Fisheries Division
Department of Natural Resources
Stevens T. Mason Building
Lansing, Michigan 48926

Dear Mr. Fogle:

Supplementing our telephone conversation of 17 June, 1976, I will reiterate my request concerning the Hammond Bay Refuge Harbor. Tetra Tech, Inc., is currently investigating the Hammond Bay Shoreline in a Corps-of-Engineers sponsored study of erosion damage attributable to the refuge harbor structures. This study will result in a proposal for Corps action to mitigate such erosion. An environmental impact statement is also being propared to present all impacts expected to accompany the project. The study area is shown on the enclosed map marked #1.

Twelve alternatives for mitigating the erosion were analyzed for engineering feasibility, economic advantage, and environmental suitability. One plan has been tentatively selected as the best overall approach to the problem. It calls for the construction of a 150-foot groin at the site of harbor-induced erosion just north of the harbor. In addition, the beach running about 450 feet north of the proposed groin will receive about 3,000 cubic yards of fill material, as shown in map #2. These combined action aspects will effectively reduce erosion in this reach and help to stabilize the shoreline extending north to Pond Point.

The Corps of Engineers is concerned that possible impacts to fish and fishing activities in the area be minimized. It is apparent that the time of year in which construction will occur will have a major role in determining expected impacts. In this regard, can you suggest a month prior to which construction, as proposed, will have a minimal effect on fish and various fishery activities?

Your cooperation in past studies has been instrumental in establishing many environmentally-sound projects, and is greatly appreciated. Please call me if you have questions or new information concerning this project. My number again is (213) 449-6400.

Sincerely,

James F. La Morte, III
Environmental Engineer
Engineering Division

JFL:sc

TETRA TECH, INC., 630 NORTH ROSEMEAD BOULEVARD • PASADENA, CALIFORNIA 91107 • (818) 449-6400

WILLIAM G. MILLIKEN, Governor
DEPARTMENT OF NATURAL RESOURCES
STEVENS T. MASON BUILDING, BOX 30028, LANSING, MICHIGAN 48909
HOWARD A. TANNER, Director

Refer to:
5500.

June 23, 1976

Mr. James F. La Morte, III
Environmental Engineer
Engineering Division
Tetra Tech, Inc.
630 North Rosemead Blvd.
Pasadena, California 91107

Dear Mr. La Morte:

This letter will confirm the information which I provided you by telephone on June 21, 1976.

It is the opinion of our field biologists having jurisdictional responsibility over the fisheries in the Hammond Bay area, that any constructional work around the harbor of refuge structure would have the least or minimal biological effect on the fisheries between late June and mid-September. At other times, prior and subsequent to the above dates, salmon and/or trout will be in the general construction area in high numbers. Any spawning and recreational fishing would be interferred with significantly at these times.

I recognize the importance of protecting the harbor of refuge structure, and further realize that construction often is limited by seasonal constraints. However, fishing recreation is the basic reason for many of our harbor refuges. It is therefore necessary that every effort be made to avoid conflict which could jeopardize the fishery.

If you have any further questions, please feel free to contact me.

Sincerely,

Ned E. Fogle
Great Lakes Management Specialist
FISHERIES DIVISION

NEF:bm

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1027
DETROIT, MICHIGAN 48231

ANNOUNCEMENT!

of

PUBLIC WORKSHOP SESSION

**STUDY OF SHORELINE EROSION MITIGATION MEASURES
FOR
HAMMOND BAY HARBOR, MICHIGAN**

WHAT FOR?

To encourage an interchange of information, and solicit opinions of citizens and organizations with regard to the study of shore damage attributed to Hammond Bay Harbor structures.

WHO SHOULD ATTEND?

Anyone interested in shore damage in the vicinity of Hammond Bay Harbor.

WHERE AND WHEN?

Rogers City Elementary School
532 West Erie St.
Rogers City, Michigan 49779
Thursday, September 16, 1976
7:30 P.M.

For additional information contact:

George Platz or David Roellig 226-6760

"THE CORPS CARES"

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

Mr. Phillip McCallister
Chief, Engineering Division
U.S. Army Engineer District, Detroit
P.O. Box 1027
Detroit, Michigan 48231

Dear Sir:

I am writing this letter as a follow up to the meeting held September 16, 1976 in Rogers City in regard to the Hammond Bay Harbor Mitigation Project. I presented several questions to the Corps and Tetra Tech. Inc. which went unanswered at the meeting. I would like to reiterate some of those questions at this time for your consideration and resolution.

1. Who owns the land on which the project will abut?
2. Who will own the improvements upon completion of the project?
3. Have the owners of the abutting property been approached regarding:
   A. Permission to cross their lands for construction purposes?
   B. Approval of project site and project method?
   C. Possible purchase by the State of Michigan ?
4. Is the Corps aware that a local realtor has told me that there will be three new buildable lots for sale upon completion of the project? Refer to question 2 above.
5. In the report it states that "sportsmen are expected to utilize the groin for fishing", (page 98, 4.41), in the next paragraph (page 98, 4.42) it states "more of the shoreland will be suitable for residential development." in other places in the report it mentions the improved value of the site. My question is, the site cannot be both a public fishing wharf AND increased property values, which is it going to be?

I would like to explain my interest in this project. I own a parcel of land directly opposite the proposed groin, across U. S. 23. The primary purpose I purchased it is because I have an unobstructed view of lake huron at at that location, and would like to keep it unobstructed.

My opinion, if the Corps ascertains it will complete the project as planned, is to encourage the Michigan Dept. of Natural Resources to purchase the land from Lot 2, Surf Park Sub. south to the present roadside park, and create a beach and fishing wharf for public use. I can furnish names and addresses of all owners upon request.

I personally am amazed at the lack of thorough investigation of the ownership situation of this project by the Corps. I hope many dollars have not been spent on this report prematurely, because without title questions cleared there may well be problems implementing the mitigative actions.

Sincerely,

William R. Woodard

William R. Woodard
1054 Marie Lane
Madison Heights, Mi. 48071
1-313-543-2276

cc: Great Lakes Area National Park Service
Michigan Department of Natural Resources
Michigan Department of State Highways
Michigan Parks Association
U.S. Department of the Interior Bureau of Outdoor Recreation
Abitibi Corp., Alpena, Michigan

NCEED-PB

29 Oct 1976

Mr. William R. Woodard
1054 Marie Lane
Madison Heights, MI 48071

Dear Mr. Woodard:

This is in response to your letter dated 7 Oct 1976, concerning the Hammond Bay Harbor Mitigation Project. The following is in response to the questions you raised.

1. The property unto which the project will abut is owned by the Abitibi Corporation, 1400 North Woodward, Birmingham, Michigan.

2. The ownership of the submerged lands or the bottomlands of the Great Lakes is by the State of Michigan. The placing of sand, even above the waterline, by the Corps of Engineers would not change the ownership of that land.

3. The owner of the abutting property has not been individually approached as to the details of the project. However, the Public Workshop Session which you attended on 16 September 1976 in Rogers City, was held for the specific purpose of publically informing all interested and/or concerned parties as to the proposed mitigation plan. The owner of the property will be contacted during the plans and specifications phase of the project.

4. The Corps of Engineers is not aware of any plan to sell land on the proposed fill area. As previously stated, the State of Michigan will be the owner of any land resulting from the filling of publicly owned shore or submerged soil.

5. It is not inconsistent to state the possibility of the groin being used as a fishing site as well as the possibility of the increased suitability of the shoreland for residential development. The zone of adverse influence caused by the navigation structures extends from the project site northward to Pond Point. Therefore, the project will have a beneficial effect on a large area of shoreline property outside of the immediate groin construction area.

NCEOC
Mr. Wm. R. Woodard

29 OCT 1976

In conclusion, any construction that would take place on the project fill area would have to be approved of by the State of Michigan. ~~Any~~ Plans by the State of Michigan D.N.R. to create a recreational area from this mitigation project have not been formulated at this time.

Thank you for your interest in the project and if I can be of any further help to you, please do not hesitate to write.

Sincerely yours,

CC: Planning Br (Plan Form Sec) ✓DMe

P. McCALLISTER
Chief, Engineering Division

SECTION 111

ENVIRONMENTAL STATEMENT

MITIGATION OF SHORE DAMAGE ATTRIBUTED TO THE FEDERAL NAVIGATION STRUCTURES AT HAMMOND BAY HARBOR, MICHIGAN

APPENDIX C

RESPONSE TO
DRAFT ENVIRONMENTAL
IMPACT STATEMENT

Advisory Council on
Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005

August 24, 1976

Mr. P. McCallister
Chief, Engineering Division
Detroit District
U.S. Army Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

Thank you for your request of July 19, 1976 for comments on the environmental statement for the proposed plans for mitigating erosion damage due to the Harbor Beach Harbor, Michigan, navigation structures. Pursuant to our responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969 and the Council's "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R., Part 800), we have determined that your draft environmental statement appears adequate concerning our area of interest, and we have no further comments to make.

Sincerely yours,

Myra F. Harrison

Myra F. Harrison
Acting Director
Office of Review
and Compliance

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE Room 101, 1405 South Harrison Road
East Lansing, Michigan 48823

August 18, 1976

U.S. Army Engineer District, Detroit
ATTN: Environmental Resources Branch
P.O. Box 1027
Detroit, Michigan 48231

Gentlemen:

The draft environmental statement for proposed plans for mitigation of shore damage attributed to the federal navigation structures at Hammond Bay Harbor, Michigan, was received by this office for review and comment.

We have reviewed the draft environmental statement and do not have any comments.

We appreciate the opportunity to review and comment on this proposed project.

Sincerely yours,

Arthur H. Cratty
State Conservationist

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technolo
Washington, D.C. 20230

August 24, 1976

Mr. P. McCallister
Detroit District, Corps of Engineers
Department of the Army
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

This is in reference to your draft environmental impact statement entitled "Mitigation of Shore Damage Attributed to the Federal Navigation Structures at Hammond Bay Harbor, Michigan." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving eight copies of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosures: Memos from Mr. Douglas Le Comte
Special Projects - EDS

Mr. Eugene J. Aubert
Director, GLERL, RF24

August 13, 1976 DX61/DLEC

TO: William Aron, Director
Office of Ecology and Environmental Conservation, EE

FROM: Douglas le Comte
Special Projects

SUBJECT: EDS Review of DEIS 7607.44 (Mitigation of Shore Damage Attributed to the Federal Navigation Structures at Hammond Bay Harbor, Michigan)

The EDS has reviewed the subject DEIS and offers the following comments:

Storm winds play an important role in shore erosion. The environmental statement states (p.53) that the "direction, magnitude, and duration of Lake Huron storms have considerable influence on shore erosion." The climate discussion, however, fails to give information on winds and storms in the subject area. The environmental statement would be improved if data on storm direction, magnitude, and duration were included, as well as information on the direction and strength of associated storm winds.

Climatological data are available from the National Climatic Center, Asheville, North Carolina 28801.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES
Great Lakes Environmental Research Laboratory
2300 Washtenaw Avenue
Ann Arbor, Michigan 48104

August 25, 1976

TO : Director
Office of Ecology and Environmental Conservation, EE

FROM : Eugene J. Aubert
Director, GLERL, R/24

SUBJECT: DEIS 7607.44 - Mitigation of Shore Damage Attributed to the Federal Navigation Structures at Hammond Bay Harbor, Michigan

The subject DEIS prepared by the Corps of Engineers, Detroit District, on mitigation of shore erosion at Hammond Bay Harbor, Lake Huron, has been reviewed and comments herewith submitted.

Placement of a rock groin supplemented by a beach fill appears to be an inexpensive way to mitigate shore damage caused by the harbor structures.

Analysis of ongoing shore processes in the Hammond Bay area neglects the role of currents. In the vicinity of Hammond Bay, the most effective waves are from easterly directions due to the longest fetch. Littoral currents generated by easterly winds are from the south to the north. In the bay, however, an anti-clockwise eddy current exists which sweeps the shore and moves the eroded sediment from north to south towards the harbor structures. Construction of the groin will deflect part of the current from the shore and will shift the location of the eddy slightly to the north. For this reason, potential of the erosion will be shifted north and, depending on the effectiveness of present shore protection structures, it may or may not develop erosion. A small clockwise eddy will form on the south side of the proposed groin causing minor erosion just south of the groin.

The main purpose of the beach fill is fast restoration of eroded sand beach. It will not diminish the erosion potential further north. Shoreline erosion at any particular location is a complex phenomenon; however, in most cases, it does not depend on location of deposition. Therefore, assumption is not correct that without the proposed beach fill the shoreline north of the proposed groin would erode to the extent of providing enough material to fill the groin through natural processes (Paragraph 4.35). It appears that erosion north of the proposed beach fill will remain the same with or without the fill and, as stated above, will depend mainly on the efficiency of existing protection structures.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

REGION V

OFFICE OF THE REGIONAL DIRECTOR

July 30, 1976

Colonel James E. Hays
District Engineer
Corps of Engineers
Department of the Army
Box 1027
Detroit, Michigan 48231

Dear Colonel Hays:

Re: DEIS - Mitigation of Shore Damage Attributed to Federal Navigation Structures at Harmond Bay Harbor, Michigan

We have reviewed the Draft Environmental Impact Statement for the above project. To our knowledge, and based upon the information provided, this project will not impact to any significant degree on the health, education or welfare of the population.

Sincerely,

Robert A. Ford

Robert A. Ford, Regional
Environmental Officer
Region V

cc: Charles Custard, OEA
Warren Muir, CEQ

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER-76/710

SEP 3 1976

Dear Colonel Hays:

Thank you for the letter of July 19, 1976, requesting our views and comments on the draft environmental statement for Mitigation of Shore Damage, Hammond Bay Harbor, Presque Isle County, Michigan. We have reviewed the document and conclude that it adequately considers those areas within our jurisdiction and expertise. We offer the following comment and suggestion for your consideration.

Additional information could be provided to better describe the fish species found in the immediate vicinity of the proposed work area. For instance, Table 12, page 68 implies that all fish species listed were recorded in the vicinity of Hammond Bay Harbor. This list, which was compiled by the Michigan Water Resources Commission, includes "Representative Important Species" from large geographical zones. In this case, Hammond Bay Harbor would be within geographical zone 2 as described in the Commission's list. Zone 2 includes northern Lake Michigan as well as northern Lake Huron. Some species in the list may not be found in the immediate work area planned for the harbor. Atlantic salmon, brook trout and sauger, for example, are not found commonly in the area as listed and should be removed from the list. Specific sampling of fish species at the site would provide the most accurate list of species likely to be impacted by groin construction.

Sincerely yours,

Ronald M. Coleman

Assistant Secretary of the Interior

Colonel James E. Hays
U.S. Army Corps of Engineers
Department of the Army
P.O. Box 1027
Detroit, Michigan 48231

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

FEDERAL HIGHWAY ADMINISTRATION
REGION 5
18209 DIXIE HIGHWAY
HOMEWOOD ILLINOIS 60430
August 5, 1976

IN REPLY REFER TO
05-00.5

U. S. Army Engineer District, Detroit
P. O. Box 1027
Detroit, Michigan 48231

Attn: Environmental Resources Branch

Gentlemen:

The draft EIS for the mitigation of shore damage attributed to the Federal navigation structures at Hammond Bay Harbor, Michigan has been reviewed and we have no comments regarding the improvement. The statement adequately addresses the possible effects this improvement may have on US-23, a Federal-aid route.

Sincerely yours,

Donald E. Trull
Regional Administrator

By: W. G. Emrich, Director
Office of Environment and Design

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (mep)
Ninth Coast Guard District
1240 East 9th St.
Cleveland, Ohio 44199
Phone: 293-3919

16475
1 August 1976

Department of the Army
Detroit District, Corps of Engineers
P. O. Box 1027
Detroit, Michigan 48231

Re: DEIS Mitigation of Shore Damage Attributed to the Federal Navigation Structures at Hammond Bay Harbor, Michigan

Dear Sir:

The Draft Environmental Impact Statement, referenced above, has been reviewed by this office and at this time we offer no comments.

Sincerely,

W. C. OCHMAN
Captain, U. S. Coast Guard
Chief, Marine Safety Division
By direction of the Commander,
Ninth Coast Guard District

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST
CHICAGO, ILLINOIS 60604

SEP 15 1976

Mr. P. McCallister
Chief, Engineering Division
Department of the Army
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

We have completed our review the Draft Environmental Impact Statement for Mitigation of Shore Damage Attributed to the Federal Navigation Structures at Hammond Bay Harbor, Michigan as requested in your letter of July 19, 1976. In general, we have no major objections to the proposed action and believe the EIS is adequate. We offer the following comments for your consideration.

It would be helpful to indicate in the Final EIS the extent that high lake levels have contributed to the increased erosion north of the harbor and their affect on the southerly drift component.

We have classified our comments on the project as LO (lack of objection) and on the EIS as category 1 (adequate). The date and classification of our comments will be published in the Federal Register in accordance with our agency's responsibility to review other Agencies' projects.

We appreciate the opportunity to review such a well-prepared Draft EIS.

Sincerely yours,

Gary A. Williams

Gary A. Williams
Chief, Environmental Review Section

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING, BOX 30028, LANSING, MICHIGAN 48909

HOWARD A. TANNER, Director

August 31, 1976

U.S. Army Engineer District, Detroit
ATTN: Environmental Resources Branch
P.O. Box 1027
Detroit, Michigan

Re: NCEED-ER

Dear Mr. McCallister:

We have reviewed the draft environmental statement for the proposed mitigat of shore damage at Hammond Bay Harbor. We find the statement generally acceptable in scope and content.

The attached analysis prepared by our Office of Program Review and Project Clearance represents the Department's views on this proposal. We feel the long term effects of the placement of a groin and fill may have eventual effects on the shoreline to the north which lies between this site and Pond Point. These possible effects should be evaluated in more detail. The remainder of the comments deal with considerations of public access, reveget and corrections in the text.

Should you have any questions in regard to this analysis, please contact us.

Sincerely,

Howard A. Tanner

Howard A. Tanner
Director

Analysis of the U.S. Army Corps of Engineer,
Detroit District, Draft Environmental
Statement for the Proposed Mitigation of
Shore Damage Attributed to the Federal
Navigation Structures at Hammond Bay

Michigan Department of Natural Resources
August 31, 1976

The environmental statement, for the most part, adequately and comprehensively describes the mitigation project and associated impacts. However, there are portions of the document which need additional information and corrections.

We do not feel that the statement thoroughly assesses the possible impact of the groin on shoreline problems just north of the groin and fill site. It is indicated that erosion will be abated along 1,500 feet of shoreline subject to erosion north of the groin placement (page 91, 4.20). It is not clear from the information provided that the proposed groin and fill will not eventually transfer the more critical shoreline erosion problems to that area between the groin and Pond Point. This possibility should be more extensively examined in the final statement. Since there is a possibility that the groin and fill may bring only short term relief from erosion problems, effects on existing groins in similar situations along the Great Lakes shores should be evaluated and reported in the statement.

Page 11, paragraph 2
Is the access property now in public ownership, or can it become publically owned to provide limited fishing access?

Page 11, paragraph 3
The clean up should include mulching and revegetation with plant materials which will provide a matted root (such as willows or red osier dogwood) to protect against further erosion.

Page 14, Section 1.19
Some mention should be made of the negative aesthetic impact of the groin. It is not likely that the beauty of a groin will replace the natural beach beauty which existed prior to 1963.

Atlantic salmon (Salmo salar) is not a common species. It was introduced into Lake Huron, but is no longer being stocked there.

Rainbow smelt (Osmerus esperlantus) should be corrected to read (Osmerus mordax).

We would also suggest that the subspecies listing of "vitreum" and "griseum", respectively on walleye and sauger be dropped. Also, sauger is not common in Lake Michigan.

Page 69, Section 2.86
It is indicated in this paragraph that rainbow trout make upstream runs in September and October and, after spawning, return downstream in May and June. Actually, Michigan rainbow trout are primarily spring spawners, running upstream April through early May to spawn. It should be noted, however, that some fish do make fall runs.

Page 75, Section 2.92
The fifth sentence should read "Lake Huron's", rather than "Lake Michigan's", sport fisheries. Also, in the last sentence on that page, after 1967, add "and lake trout in the early 70's".

Page 85, Section 4.04
In this paragraph, such factors as commercial and industrial uses, desirable regional growth, community cohesion, etc., are listed as environmental factors These are not environmental factors, but rather, economical factors.

Page 87, Section 4.09
Relative to groins, it is stated in this paragraph that the smothered benthic habitat is a very small portion of the existing benthic habitat and the adverse impact is expected to be insignificant. This may or may not be true of the large scale habitat; however, it could be quite significant on the local basis. Further, in the last sentence of this paragraph, it is stated that where gravels and cobbles are subjected to the effect of waves, it is conspicuously devoid of animals. This is wrong. Such areas are normally quite rich in aquatic fauna.

Page 92, Section 4.23
It is again mentioned in this paragraph that the wave-washed and gravel-strewn section of the littoral zone is characteristically devoid of organisms. As previously mentioned, this is incorrect.

Page 93, Section 4.26
The last sentence should be rewritten to read, "Any adverse impacts, should they occur, would most likely be of low magnitude and not of significant degree to harm the local fauna".

Page 119, Section 6.12
This paragraph should specify the type of aquatic organisms which could be lost as the result of this operation.

Sincerely,

Jack D. Bails

Jack D. Bails
Chief
Office of Program Review and
Project Clearance

JDB:SFC:ml

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

STATE HIGHWAYS BUILDING, 425 WEST OTTAWA PHONE 517-373-2090
POST OFFICE DRAWER K, LANSING, MICHIGAN 48904

JOHN P. WOODFORD, DIRECTOR

August 9, 1976

Mr. P. McCallister, Chief
Engineering Division
U. S. Army Engineer District, Detroit
Environmental Resources Branch
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

The Environmental and Community Factors Division has reviewed the Draft Environmental Statement for Mitigation of Shore Damage Attributed to the Federal Navigation Structures at Hammond Bay Harbor, Michigan. The following suggestions are offered to increase the adequacy of the Statement:

A biological inventory of the site should be included. Small special environments are scattered along Michigan beaches. Many have been identified and described in articles and papers. Others are known by local experts. However, no complete inventory has ever been made for Michigan. Therefore, unless references are available which describe the affected site, the reader has no basis to judge the uniqueness of the communities present without an inventory.

US-23 is only about 150 feet from the impacted area. Discussion of adverse impacts due to the use of trucks and other heavy equipment during construction should include the negative impact on the condition of the highway and the resulting increased maintenance cost to Michigan taxpayers.

Concentration of trucks and construction equipment on a Michigan trunkline may reduce motorist safety. This problem should be addressed.

No reference is made to the possibility that the results of this action may protect US-23 against future undermining, due to shoreline erosion. If this possibility exists, it should be included as a positive impact.

Total destroyed terrestrial vegetation and benthic habitat is commendably small. The total additional area receiving observable environmental impacts should also be estimated.

The following suggestions are offered to increase the quality of the Statement:

pp. - 2.1 It would be more appropriate to state that 47 potential impacts have been identified, since classification of impacts varies among investigators, and since there may be unidentified impacts involved. Since a specific number is given, they should be listed.

pp. - 17 - 81 The Environmental Setting Without the Project is rather lengthy considering the scope of the project. Perhaps part of the material could be incorporated into an appendix.

This section contains numerous technical errors, some of which we have repeatedly identified in previous U. S. Army Corps of Engineer Impact Statements prepared by Tetra Tech, Incorporated, but which continue to appear. An example of such an error is the appearance in Table 13 of "Long-necked Pheasant" rather than "Ring-necked Pheasant." We suggest that Tetra Tech, Incorporated correct its files as it revises the Environmental Statement.

Some of the tables are incomplete, or at least have misleading titles. For example, Table 10 "Indigenous Tree Species of Michigan" lists only 30 species. Table 11 "Plant Species Recorded for the Northern Half of Michigan's Lower Peninsula" also lists only 30 species, all beach plants. These should have titles revised to reflect what the lists actually represent.

pp. 103 - 115 Table 18 was of very little use in evaluating the project. It should be remodeled or removed.

Sincerely,

G. Robert Adams, Administrator
Environmental and Community
Factors Division

Aug 22

Dear Sir

We have read the environmental impact study in regard to the shoreline protective works which the Corps of Engineers is proposing to build on Hammond Bay, as indicated in the project study we have suffered considerable damage to our property due to erosion since the refuge Harbor was built and have had to spend a large amount of money so that we wouldn't completly lose our property.

It appears to us that the proposed construction of the wall will cause further erosion to our property unless the shoreline is strengthened and the wall is extended further in the lake.

secondly the construction of the wall will undoubtly interfere with the normal use of our cottage and may cause damage since we have the nearest building and thus that the most damage trees - wall - et cetera

Sincerely

Mrs Mrs Joseph Truss
27360 Newland
Warren, Mich
48093

1

21712 Ten Mile Road,
St. Clair Shores,
Michigan, 48080,
September 13, 1976.

Dept. of the Army,
Detroit District Corps. of Engineers,
P.O. Box 1027,
Detroit, Michigan, 48231.

Attention of:- Mr. David Kelley

Gentlemen:-

Thank you for your notice of the meeting being held at Rogers City on Thursday, Sept. 16th., which will be a Public Workshop Session to make a Study of Shoreline Erosion Mitigation Measures for Hammond Bay Harbor, Michigan.

I regret that I will be unable to attend this most interesting and desirable meeting, due to work. I will be ... the meeting in spirit, since I am one of the two Sprucemont home owners that would be affected by the proposed mitigation project, and I am heartily in favor of it, as are my neighbors, the Musch

I have thoroughly read thru the comprehensive and enlightening Environmental Statement, issued by your Corps., on the Mitigation Project at the Hammond Bay Refuge Harbor. As a professional engineer, I am in complete accord with the proposals contained in your report to mitigate the damages already sustained, to ... prevent additional damages from occurring to the shoreline in subject area.

C-18 (Contd.)

(2)

Kress
9/13/76

The shoreline damage, if unchecked, will render our property of little, or no value, in a matter of years. We, along with our neighbors, the Vidaks, wish to occupy our homes, on a semi-permanent basis, after retirement. We both will be retiring within the next year or two.

As shown in your report, we have, as individuals, done all that we can to protect our shorelines from further erosion. However, if we do not receive the aid, as outlined in your statement, we fear what the elements may wreak, in time to come. Our wooden plank sea-wall could very conceivably be destroyed. It has been installed at a considerable personal expenditure of funds.

I would like to go on record, at the meeting being held this coming Thursday as being 100% in favor of the Corps' recommendations outlined in their statement.

I would greatly appreciate being advised as to the outcome of this meeting; and being kept abreast of the news as to what is going to be done about the proposed project.

Thank you very much.

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

Respectfully yours,

Alex Kress